Lawrence Berkeley National Laboratory

EHS 0348

Chemical Hygiene and Safety Training

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Chemical Hygiene and Safety Training

This is the .pdf version of the online training.

After reading this training, please use the link at the end to access the online quiz. After passing the quiz, you will receive credit for the training. If you need assistance, or have questions about this training, please contact EHS Training (510) 495-2228, or email ehs_training@lbl.gov

Module 1: Course Introduction

Click the video below to view the introduction

Overview of Chemical Hygiene & Safety Plan

Click the video below for an overview of the EHS Chemical Hygiene and Safety Plan

Safety at LBNL is a Team Effort

Notes

Safety at LBNL is a team effort. It involves coordination with your work lead (or PI), the Division Safety Coordinator, and EHS safety professionals.

- A work Lead guides the day-to-day activities of your work. He or she is your primary point of contact. They are also the person who will likely provide on-the-job training. You should contact your work lead whenever you have questions about the safety of your work.
- A Division Safety Coordinator provides safety support within your Division. You should get to know your Division Safety Coordinator.
- EHS Safety professionals are subject matter experts. They provide the necessary expertise, and are always available for consultation.

Safety at LBNL is a Team Effort

Please read this excerpt from the Chemical Hygiene and Safety plan regarding line management's safety responsibilities.

Line management responsibilities

"Supervisors, managers, and Work Leads are part of the safety line management chain from each worker to the Laboratory Director. Supervisors and Managers are part of the formal management chain, and they have the responsibility for adhering to all EH&S policies and safe work practices. Work leads (who may be non-management) derive authority from formal laboratory managers and/or supervisors to ensure that day-to-day work, operations, and activities in their assigned area(s) and activities are conducted safely and within established work authorizations. Supervisors, managers and work leads are collectively referred to as

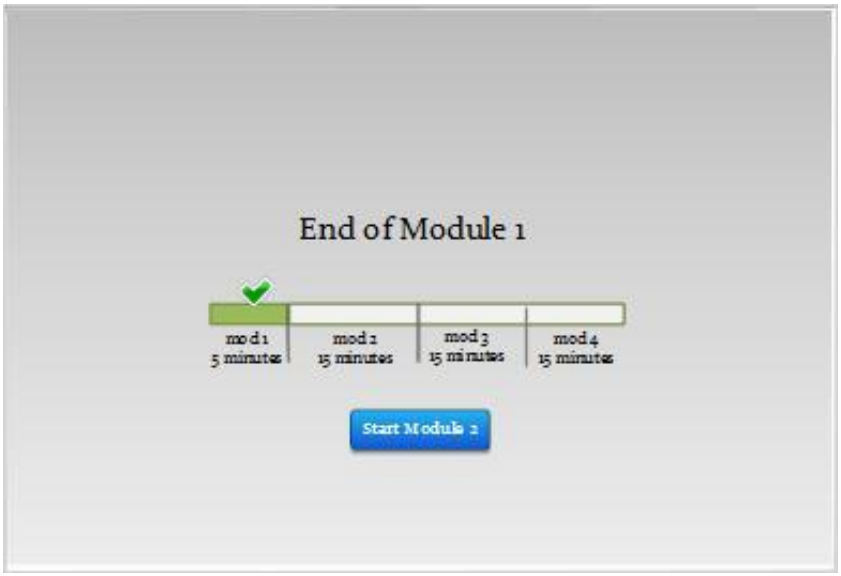
"safety line management.

Supervisors, managers and Work Leads

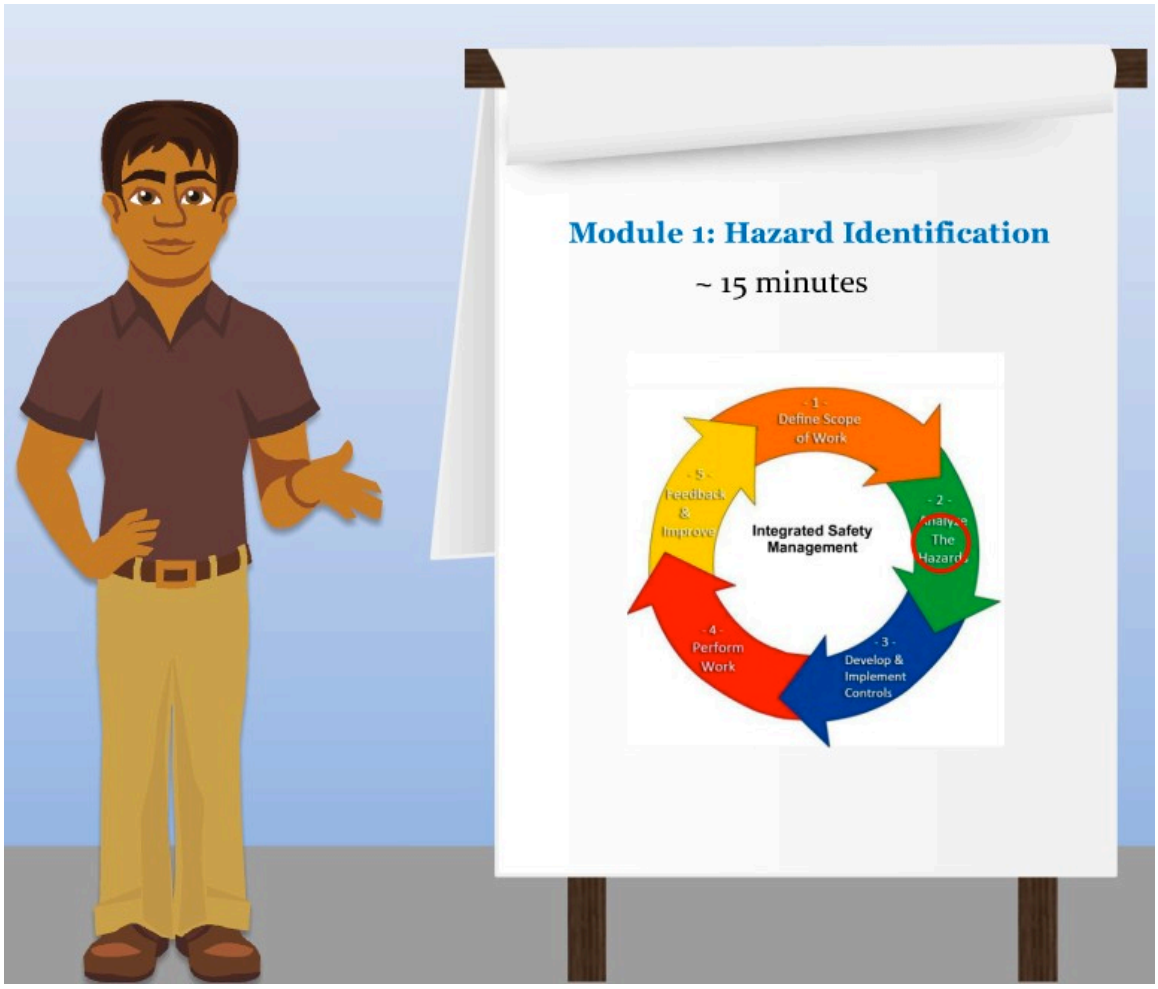
Follow PUB-3000, Chapter 6, "Safe Work Authorizations" to identify the hazards present in the work area and establish the necessary controls.

2. Ensure that Activity Hazard Documents (AHDs) are completed for applicable operations.
3. Ensure that employees complete a Job Hazards Analysis (JHA) *and complete all required training*.
4. *Provide specific training on the hazards and safety precautions related to each employee's assigned work.*
5. *Ensure that equipment and chemical containers are adequately* labeled
6. Post work areas with a Caution Placard that depicts the hazards in the area.
7. *Maintain a current chemical inventory of the hazardous materials stored in the work area by using the Chemical Management System.*

8. Ensure that corrective actions identified from accident investigations and laboratory/shop inspections are implemented.



Module 2: Identifying Hazards



Notes:
In this module we go over how to identify the hazardous properties of the chemicals that you use, or, that exist in your work area.

Globally Harmonized System of Classification and Labeling (GHS)

Notes:
Before we get much further, it's important that you understand that there are changes that are taking place affecting how hazards will be communicated in the years ahead. OSHA (or the occupational, safety and health administration) is aligning to the United Nations' Globally harmonized system of classification and labeling of chemicals (known as GHS). This change provides consistency so that chemical labels, hazard pictograms and safety data sheets are the same from product-to-product, and consistent all around the world.

GHS Pictograms

Notes:
The chart above shows the new GHS hazard pictograms. Some of these may already be familiar. However, the pictograms highlighted are new.

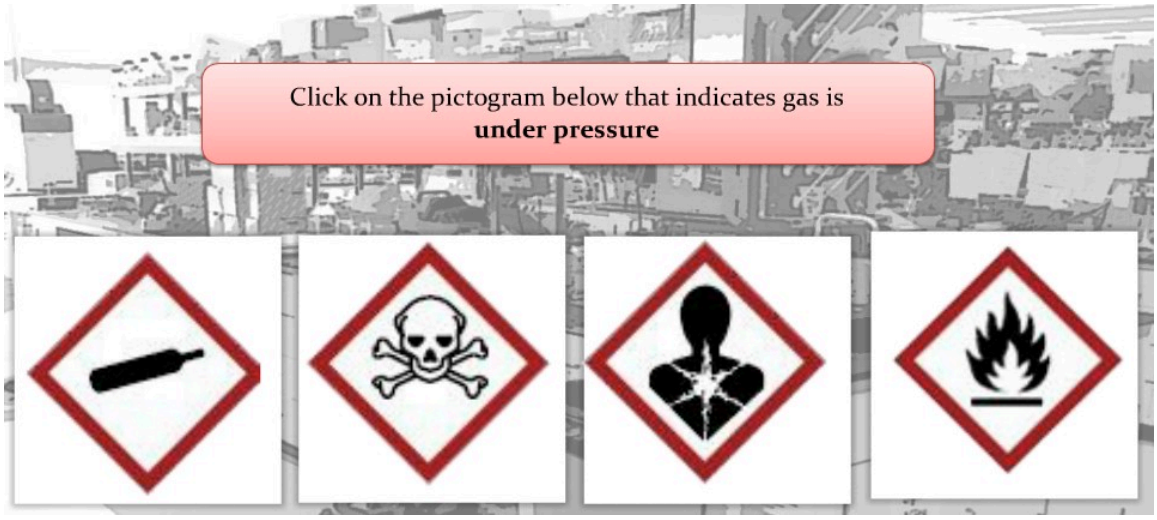
These hazards can be broken down into two broad divisions: Health Hazards, and Physical Hazards.

- Health Hazards are substances that can cause illness or death
- Physical Hazards are substances that can threaten physical safety

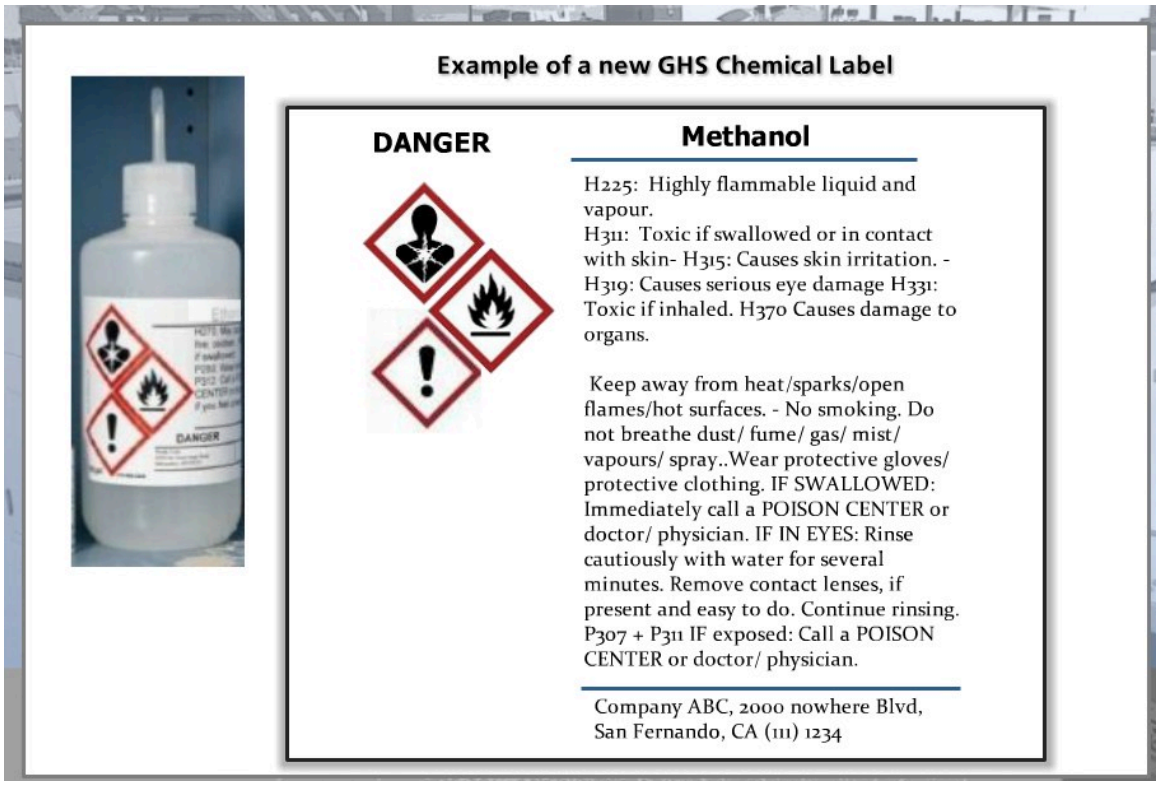
What do you think?

Notes:
Now that you have been introduced to the new GHS hazard pictograms, click on the new GHS pictogram that indicates a chemical poses a health hazard.

What do you think?



GHS Labels Overview



Now we turn our attention to the new GHS chemical labels which allow you to quickly identify the principal hazards and precautions of the chemicals you use.
For example, they have standardized signal words used to quickly indicate the level of severity of hazard (Danger being the most severe and Warning less severe).
They provide immediate visual reminders of the hazards. They have hazard statements to quickly alert you of the hazardous properties, and precautionary statements which, for example, can be used to quickly locate information on first aid response.

Safety Data Sheets

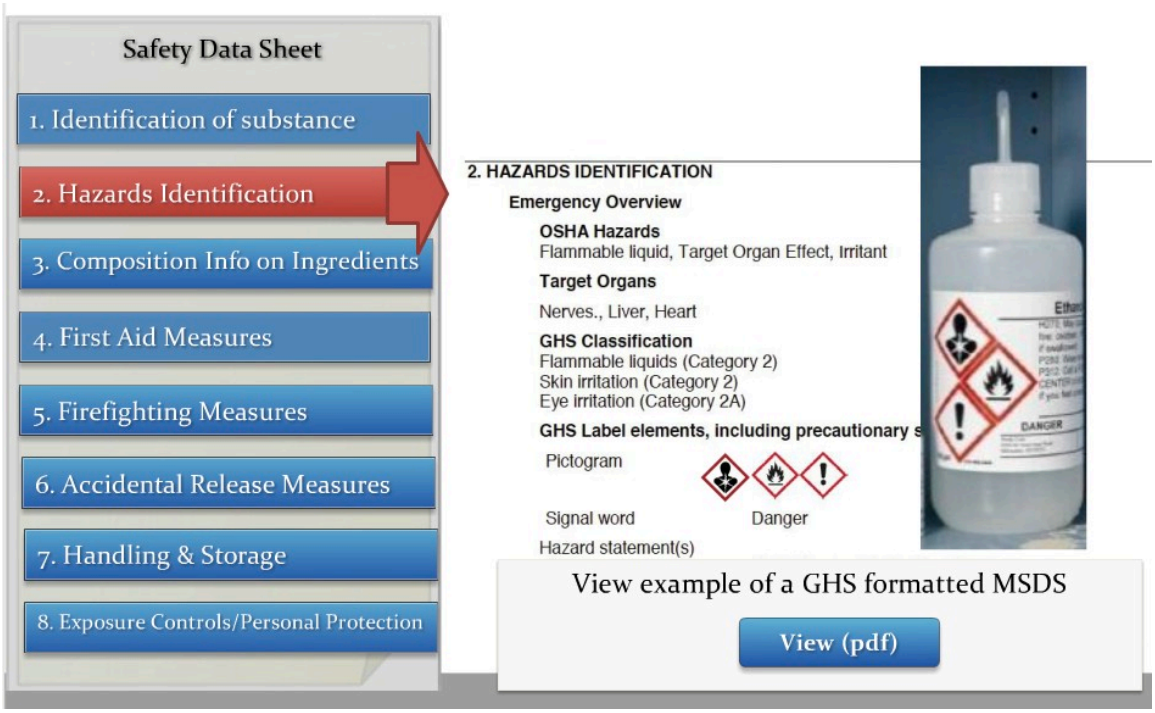
Even though chemical labels present concise summaries of the principal hazards, they best serve as reminders. A much better source of information is the Safety Data Sheet (SDS). These are required for all chemical products. you should review a safety data sheet before you start work with a chemical.

To clarify under the new Globally Harmonized system of classification and labeling Material Safety Data Sheets are called Safety data Sheets. The benefit is that the new safety data sheets provide a consistently structured 16 section format that is the same from one to the next.

The following video provides an overview of some of the information presented in an SDS.

Video overview of Safety Data Sheet

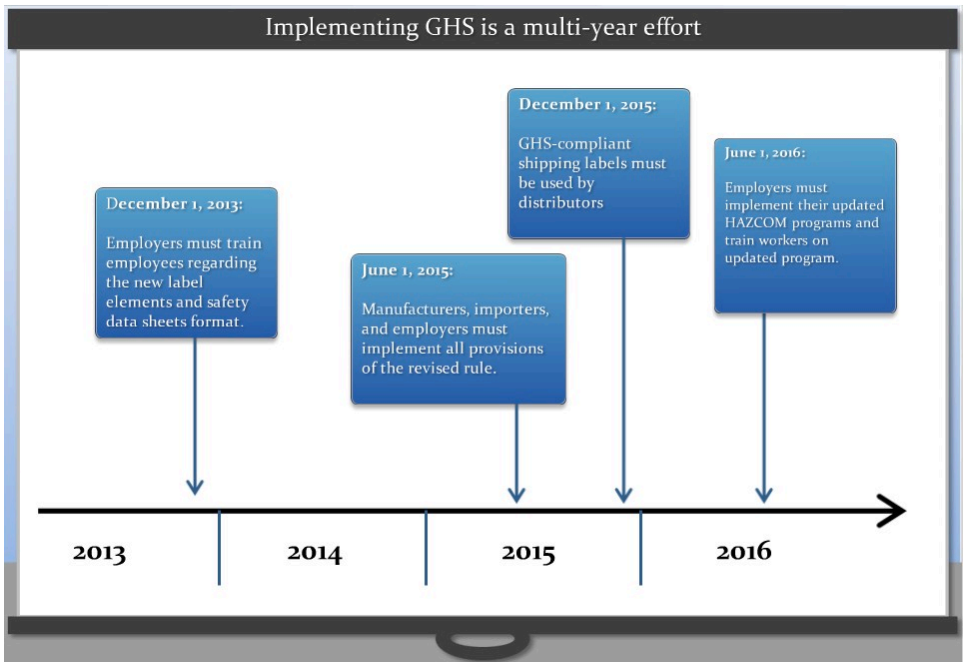
Safety Data Sheet & Labels



Since GHS is aimed at providing consistent information, some of the information presented on a chemical label is the same as what is presented on an SDS. For example, the precautionary statement and pictograms available in section 2 of an SDS would be the same as what appears on the chemical label.

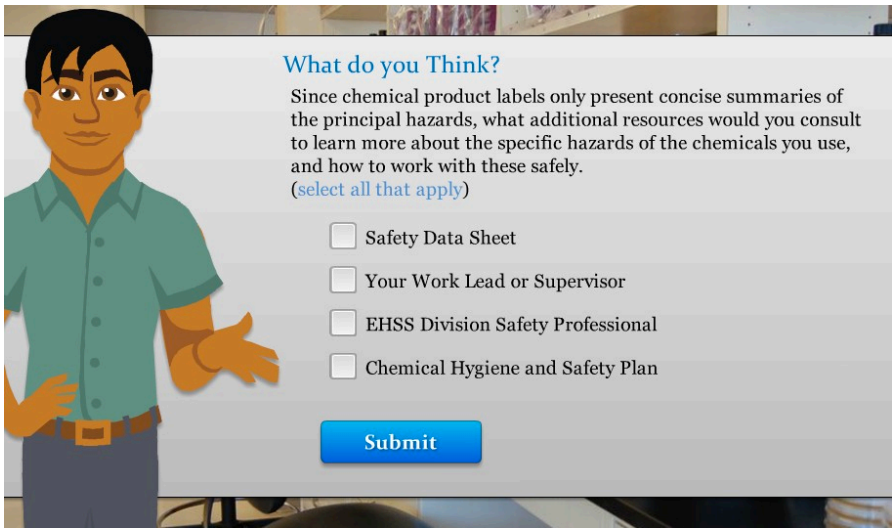
If you want to view an actual MSDS that follows the GHS format, use the button view pdf.

Summary

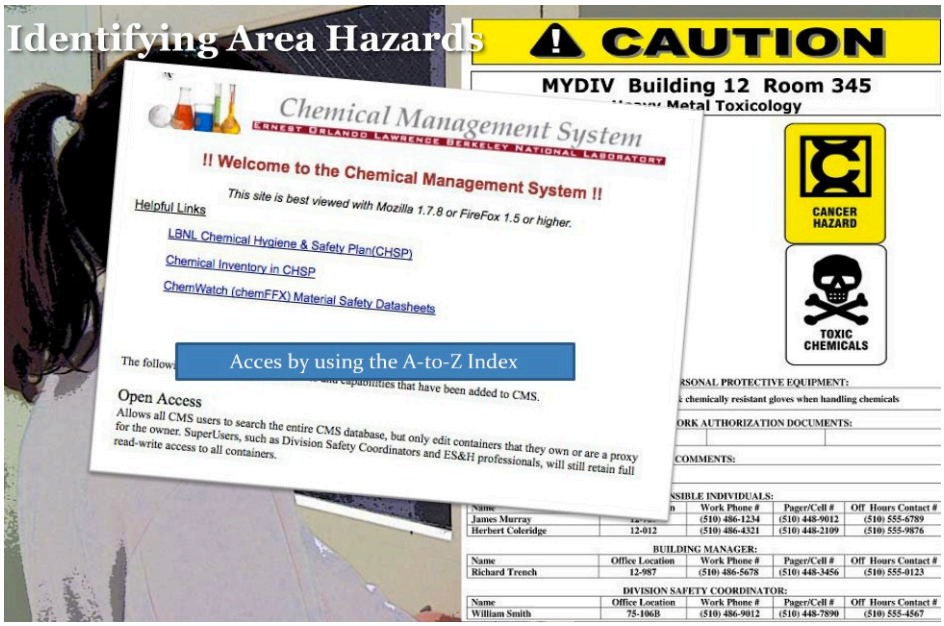


Notes:
But it's important to understand that implementing this new hazard communication system is a multi year effort as shown by this timeline. This means that during and even after the implementation that you will encounter chemicals with new labels alongside chemicals with old labels simply because you may still have older chemicals still in inventory. It also means that the pictograms used on door signs may still bear the familiar symbols until these are changed, and it means that you may encounter both material safety data sheets and the new safety data sheets in the course of your work.

What do you think?

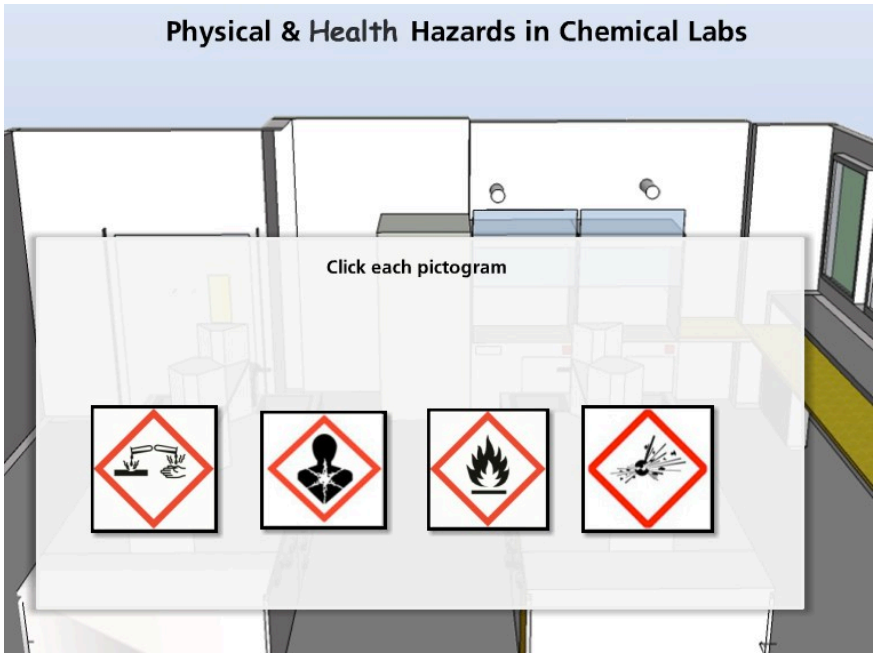


Caution Placards



If you are new to LBNL you may be learning that caution placards allow you to quickly identify the hazards that exist in an area, the minimum PPE requirements and the contact information for the responsible individuals including building manager and Division Safety Coordinator. However, you may not know that you can get specific information about what chemicals exist in an area by using LBNL's Chemical management system. This is a web-based chemical inventory available to everyone.

Physical and Health hazards at LBNL



In this lab there are a range of chemical hazards that you may encounter at LBNL in the course of your work.

6.1 Corrosives

As you may already know, corrosives include acids and bases. You may also know that acids and bases are incompatible with each other, and mixing the two could result in an aggressive reaction. Even diluting acids and bases can cause an exothermic reaction, so learning the proper method is important.

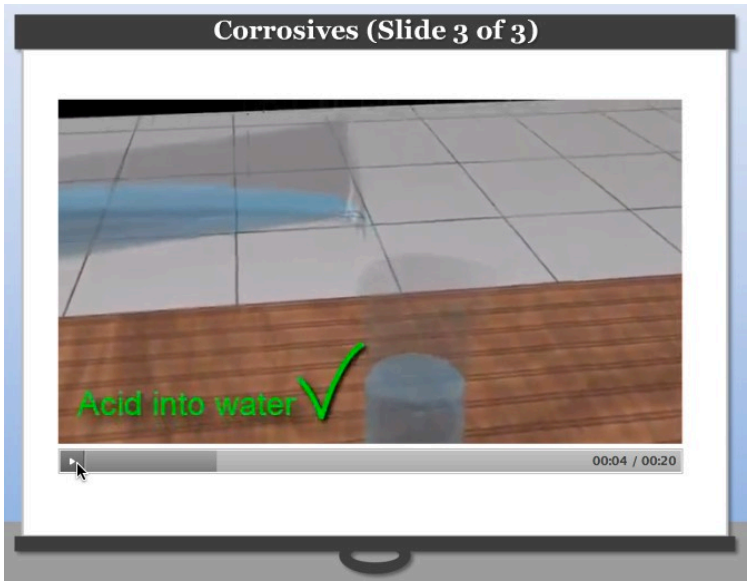
Concentrated acids are not flammable, but a fire can result from an oxidizing acid mixing with other chemicals or materials, especially flammable liquids. Acids also react with metals to produce flammable hydrogen gas.

Before working with corrosives, discuss the procedure with your work lead to ensure proper safety measures.

Corrosives injury

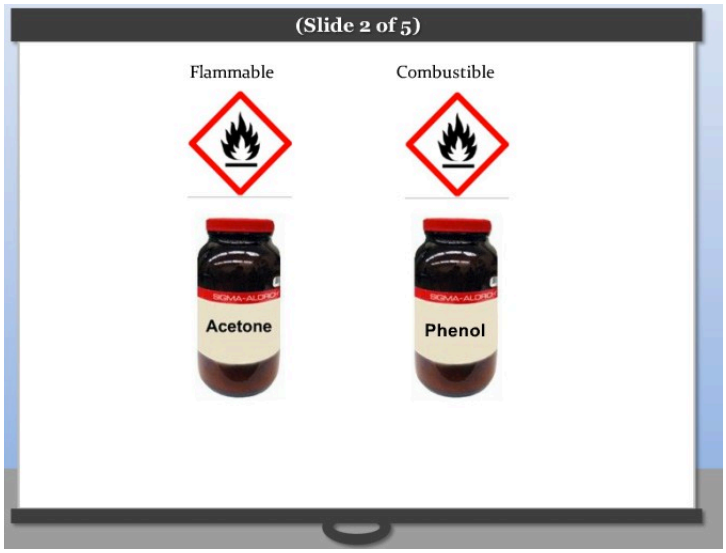
Personal exposure to corrosives can cause immediate tissue damage to the skin, eyes, and respiratory system. This person was splashed with a strong corrosive chemical (Oleylamine) and suffered severe burns. Again, this underscores the need to discuss your work with your work lead who will help you identify the appropriate protective measures for your safety which are covered in the next module.

Diluting Acids



from a UCSD Lab Safety video "To be (Safe) or not to be that can be viewed via YouTube: http://www.youtube.com/watch?feature=player_embedded&v=YdYapyzJNsE#t=248

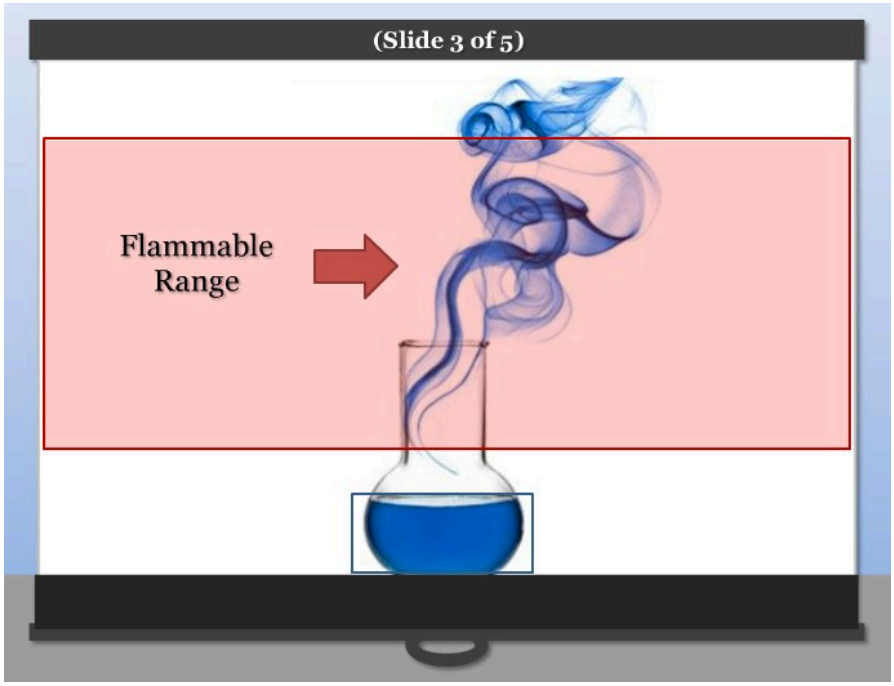
Flammables



The most common flammable and combustible chemicals at LBNL are organic solvents such as acetone (a flammable) and phenol (a combustible). As a rule, which do you think is more hazardous, flammables or combustibles? Click to choose.

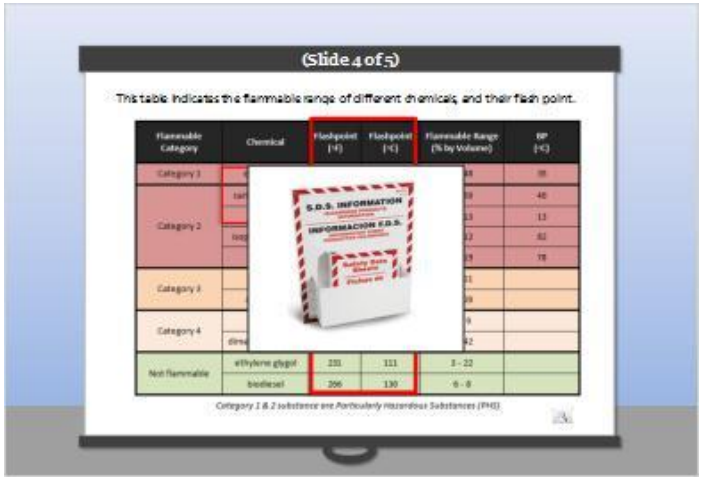
Feedback: Correct
Correct Flammable liquids are more hazardous than combustible liquids. for the simple fact that they will ignite much more easily - Flammables ignite under ambient conditions and room temperature. Whereas combustible liquids will not.

Flammable Range



It's important to understand that it is the vapor, and not the liquid that is at risk of being ignited. The vapor concentration that will burn in air is known as the Flammable Range. This is expressed as a percentage of vapor in air by volume. Vapor concentrations that are in the upper exposure limits will not sustain combustion (burn). The same is true for concentrations in the lower exposure limits.

Flashpoint



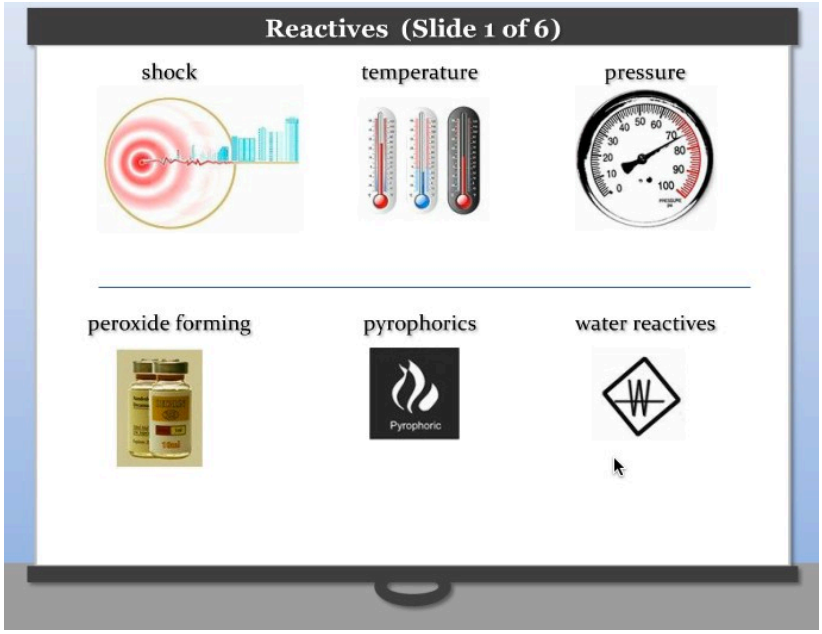
This table indicates the flammable range of different chemicals, and their flash point.

The flash point is the minimum temperature at which a flammable or combustible liquid produces enough vapor to form an ignitable mixture. As you would expect, liquids with lower

flash points pose greater flammability hazards, and flammable liquids tend to have lower flashpoints than combustible liquids.

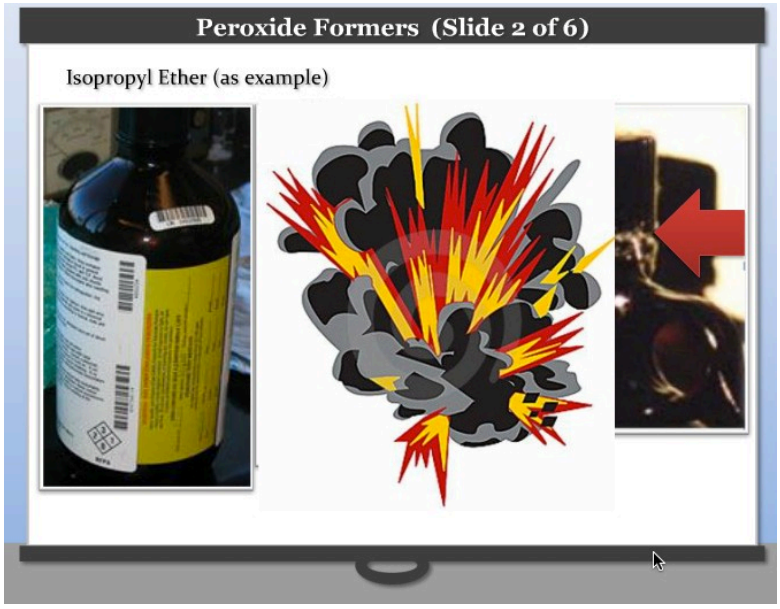
Safety data Sheets contain information about flashpoints as well as other properties such as vapor pressure and flammable range.

Reactive Chemicals



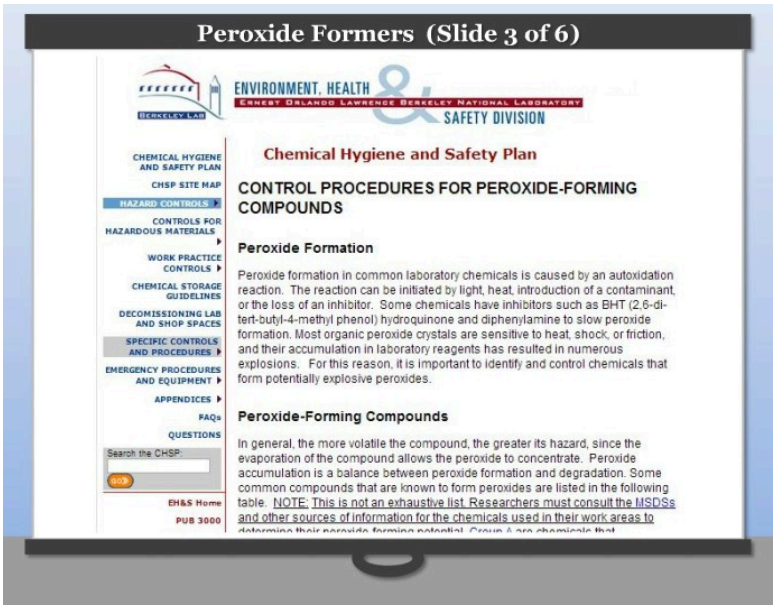
Reactive materials are solids, liquids, and gases that under conditions of shock, temperature, or pressure may vigorously polymerize, decompose, combine with other chemicals, or become self-reactive. These include peroxide forming chemicals, pyrophorics, and water reactives. We start with peroxide formers.

Peroxide Formers



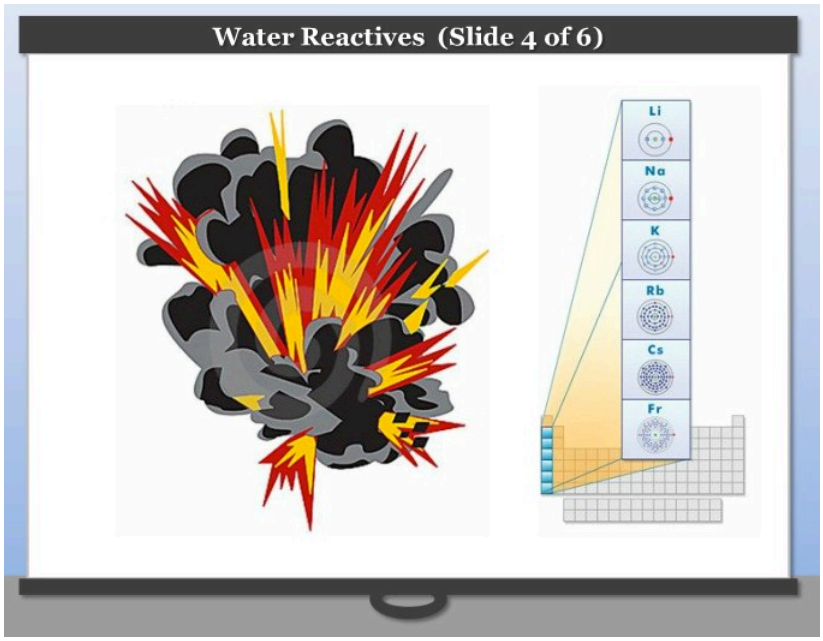
Some organic liquids (i.e., isopropyl ether) can react with oxygen in ambient air and form shock-sensitive peroxide crystals. These are called peroxide formers. Here you can see peroxide crystals have formed inside a bottle. In this example, can see the crystals have formed around the cap of the bottle.

The important thing to understand is that these are shock sensitive which means the simple act of unscrewing a cap or shaking a bottle containing peroxide crystals can cause detonation.



Peroxide formers become more dangerous with age and have safe storage times that must be observed. The Chemical Hygiene and Safety Plan has a list of common peroxide forming chemicals and describes special labeling, storage, and testing procedures you must follow. This is not an exhaustive list. You must consult the Safety data sheet and other sources of information for the chemicals used in your area to determine the peroxide forming potential

Water Reactive Chemicals

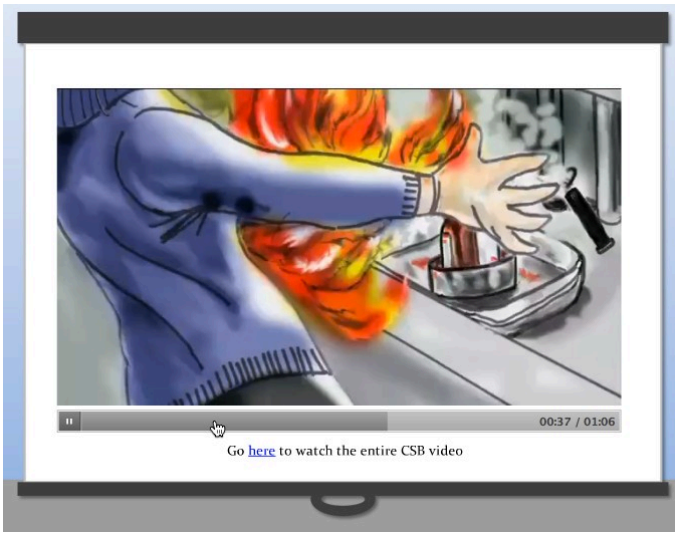


Water reactive chemicals are also very hazardous, and LBNL uses a number of water-reactive materials. As the name suggests, Water-reactive chemicals react violently with water. The reaction releases heat and, in some cases, explosive by-products.

Of chief concern are the alkali metals. Alkali metals react vigorously with water and the reaction is exothermic. The heat generated can ignite the hydrogen gas and an explosion or fire can result.

Pyrophoric Chemicals

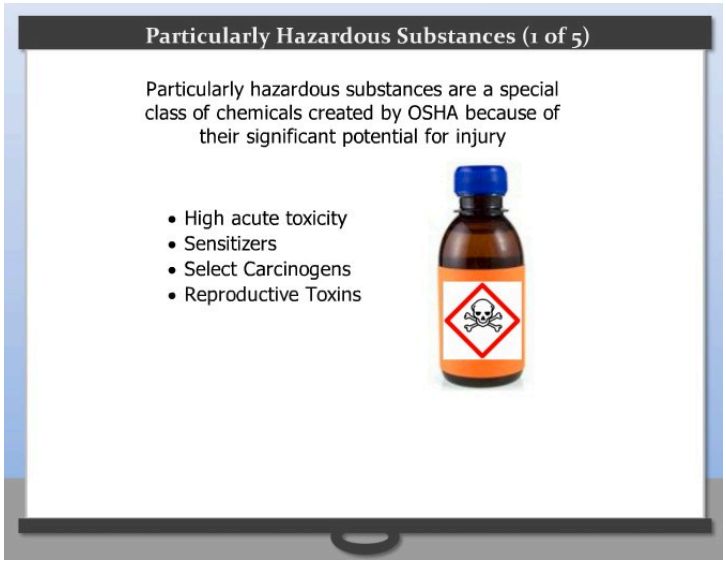
Pyrophoric chemicals are solids, liquids, and gases that spontaneously ignite when exposed to air. Moreover, they are commonly associated with flammable solvents such as pentane, hexane, heptane and diethyl ether. This combination poses a significant hazard to users. because technique and handling practices are critical, on the job training (OJT) given by a knowledgeable, experienced worker, such as the Work Lead or Principal Investigator shall be the primary training method.



This is a short excerpt from a chemical safety board video to help illustrate the danger of working with pyrophorics, and the importance of using the proper controls and having the proper training.

Go here to view full video: http://www.youtube.com/watch?v=ALBWxGik64A

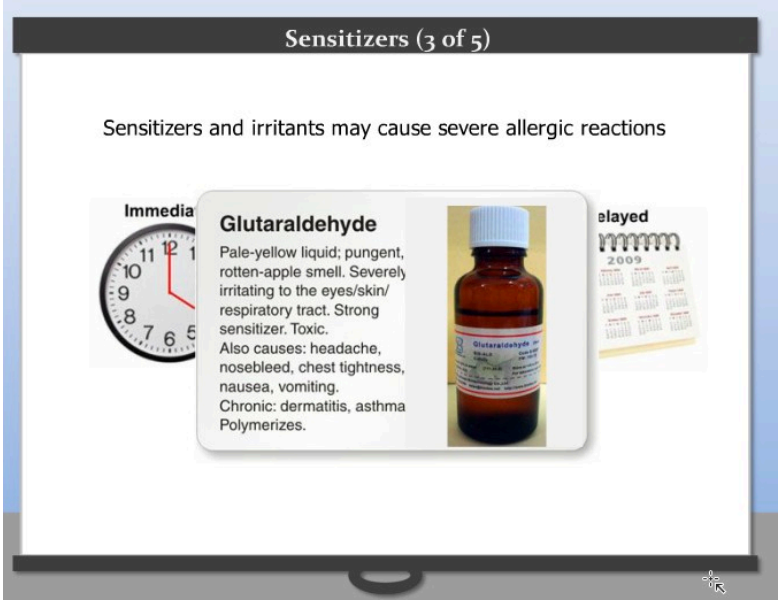
Particularly Hazardous Substances



Acutely Toxic substances

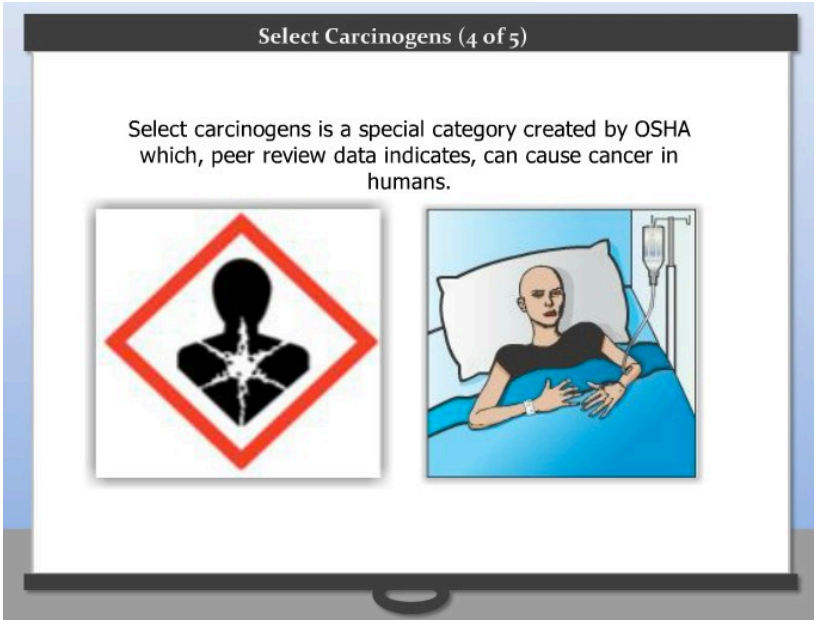
Substances of high acute toxicity may produce a debilitating condition, or even death after a single exposure. These include chemicals such as sodium cyanide and acryllo nitryl.

Sensitzers



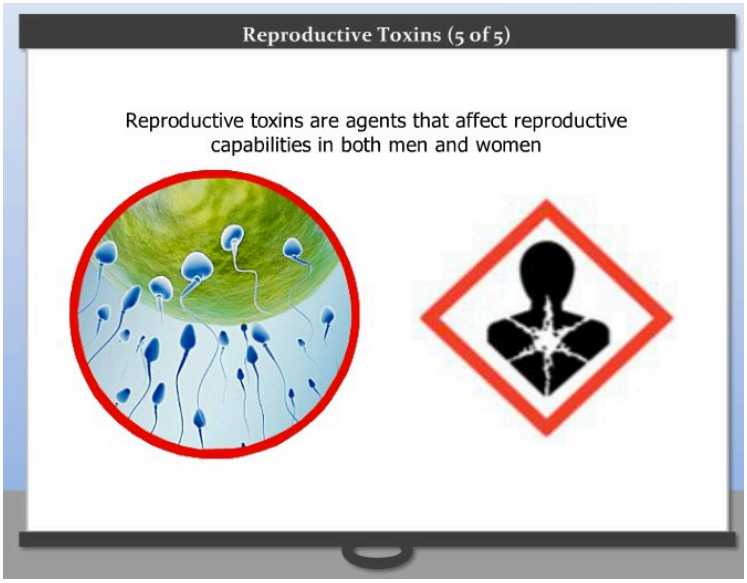
Sensitizers and irritants are chemicals that may cause severe allergic reactions. And these reactions may be immediate or delayed. An example of a sensitizer is gluteraldohyde.

Carcinogens



We know that carcinogens are chemicals that can cause malignant tumors in humans and animals. Select carcinogens is a special category created by OSHA which, peer review data indicates, can cause cancer in humans.

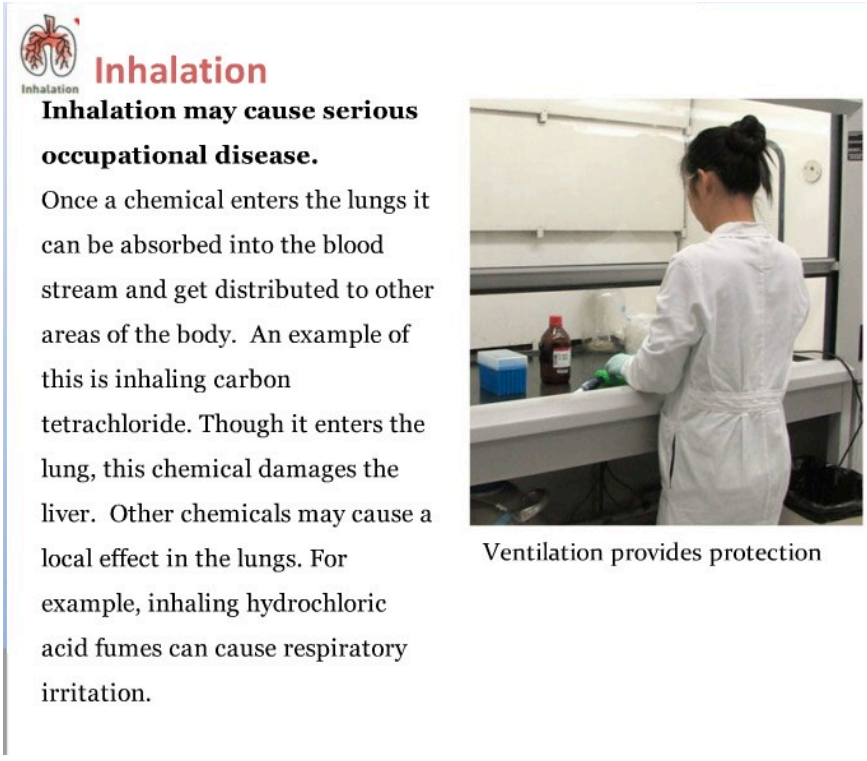
Reproductive Toxins



Finally, reproductive toxins are agents that affect reproductive capabilities in both men and women. Examples of adverse effects include impotence, low sperm count, infertility, spontaneous abortions, and birth defects. It is important to know that the first trimester of pregnancy is the period of most concern to the developing fetus, because this is when the organs and the limbs are being formed. During this period, many women may not yet be aware that they are pregnant. If you have questions or concerns you may contact Health Services to setup a consultation.

Routes of Exposure

Now that you have reviewed the hazardous properties of some of the different chemicals found at LBNL, this slide provides information on the different routes that chemicals can enter the body and the implications to health. In chemistry labs, the two most important routes of exposure are inhalation and skin contact.



Ventilation provides protection

Absorption (skin & eye contact)

Eye and skin contact with chemicals may cause irritation and burns. Some chemicals can be absorbed through the skin and be distributed to other parts of the body. For example, if methanol, a common solvent, is absorbed through the skin, it can affect the central nervous system.

It's important to recognize this and make sure you wear personal protective equipment or PPE- especially eye protection and gloves.

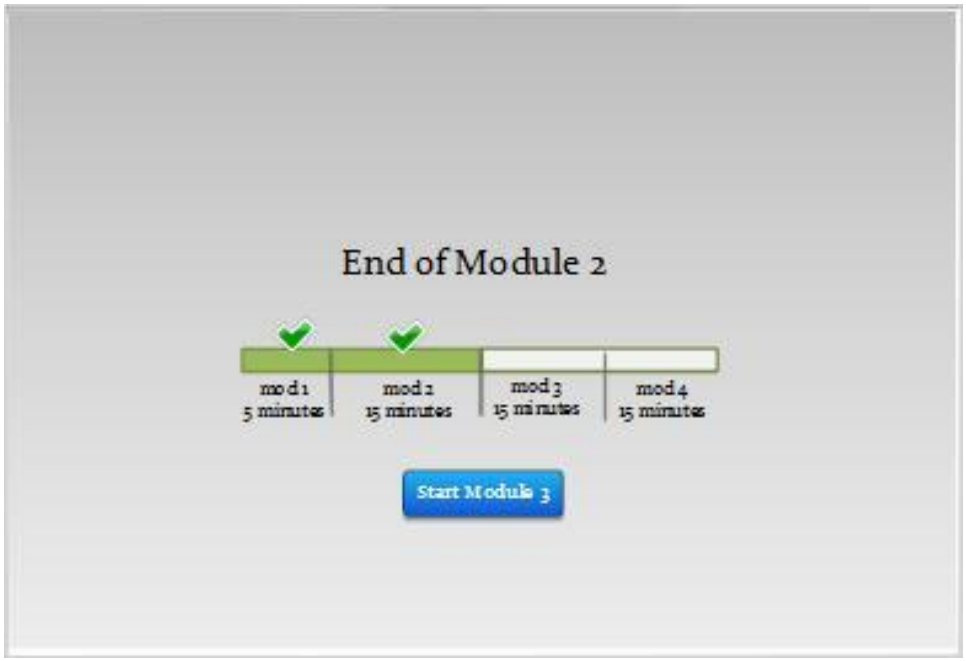
Ingestion

Ingestion is usually not a problem if you follow basic housekeeping or personal hygiene rules.

It's important to keep work areas clean, to keep food out of work areas, and to always wash your hands before eating and drinking.

Injection

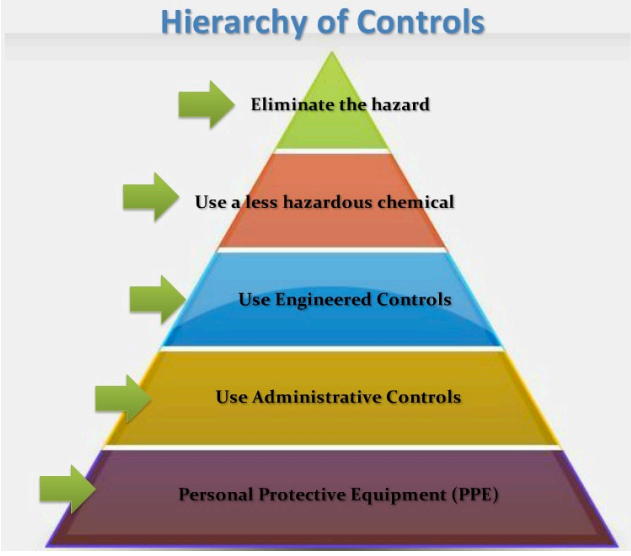
Injection is a risk when handling chemically contaminated sharps, such as razors or needles. This hazard is greatly reduced when you dispose of these items in sharps containers.



Module 3 Hazard Controls

In this module we go over the different safety controls used to protect against harmful exposure to chemicals.

Hierarchy of Controls

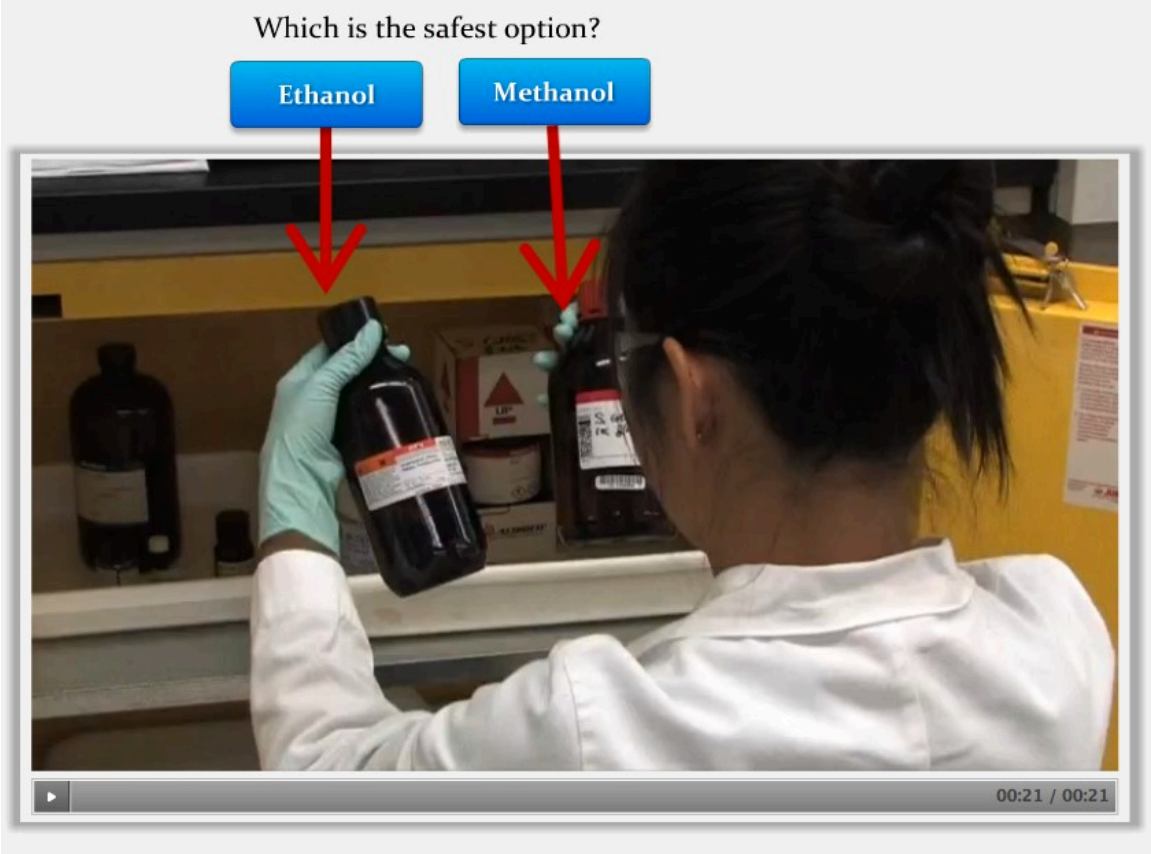


As you know, some controls are more effective than others at reducing harmful exposure to chemicals.

The hierarchy of controls is a model used to rank the effectiveness of different controls. And this model is useful for planning safe work, starting by asking:

- Is there a way we can eliminate the need for harmful chemicals in this project? If not
- Can we replace the chemical with a safer alternative?
- What engineered controls will help reduce exposure
- Are there safe work procedures to follow
- What is the best PPE for this type of work?

Choose a safer substitute



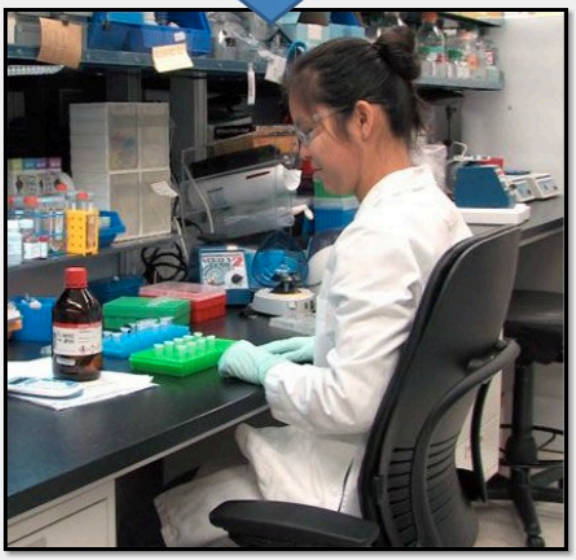
Since we cannot often eliminate the hazard all together choosing a less hazardous substance is the next best thing. Angie needs to use a solvent as part of her experiment, and has two options, ethanol, and methanol. Both are low molecular weight aliphatic alcohols, and both have the same relative degree of flammability.

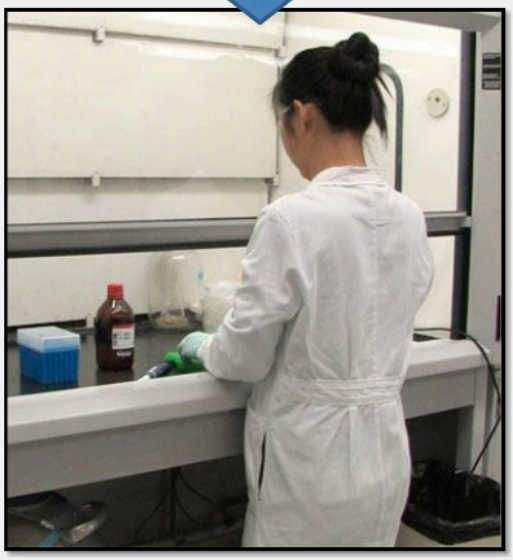
However, according to the Safety Data Sheets for these materials, methanol is more toxic than ethanol by inhalation and can be absorbed through the skin.

Q: With this in mind which is the safest option to use (Ethanol) or (Methanol)?

What do you Think?

The researcher does choose ethanol because it is less toxic than methanol. However, she understands that ethanol is flammable, and produces fumes that are hazardous to breathe.





The researcher does end up choosing ethanol because it is less toxic than methanol, but she understands that ethanol is flammable, and produces fumes that are hazardous to breathe. because of this, where would you recommend this researcher perform her work?

- Option 1 (Left) On the bench top, or in the fumehood?
- Option 2 (Right) Choose by clicking on the image.

Feedback: If you are using any chemical in a way that could produce an airborne gas, vapor, mist, dust, or fume, the operation should be conducted in a fume hood or glove box. This will reduce or eliminate the risk of exposure by inhalation. Working with the hood sash lowered prevents splashes to the eyes, face, and body.

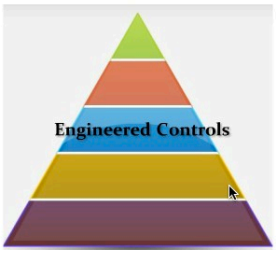
Glove Boxes

Glove Boxes

A glove box is a sealed workspace with built-in gloves that allows you to manipulate objects in a non-reactive atmosphere, for example when working with air and water-reactive materials..

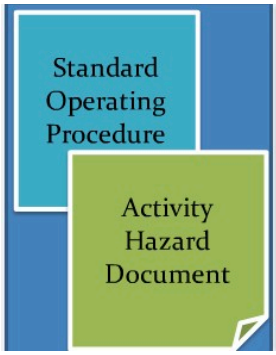
Glove boxes allow you to:

- Perform tasks without breaking containment
- Work with air and water-reactive materials



For some chemical processes a fume hood does not provide adequate protection so a glove box is used.

Administrative Controls



Administrative controls are less effective than using a less hazardous substance and using engineered controls, but they do play an important role in your safety. Examples include:

- following safe-work procedures, and work authorizations,
- reading hazard signs and warning labels,
- and completing on-the-job training.

On-the-job training is especially important because you cannot work with chemicals unsupervised until:

- your work lead has observed you demonstrate proficiency in safely handling and using chemicals.
- and both you and your work lead are confident that you can perform the work safely.

PPE Intro

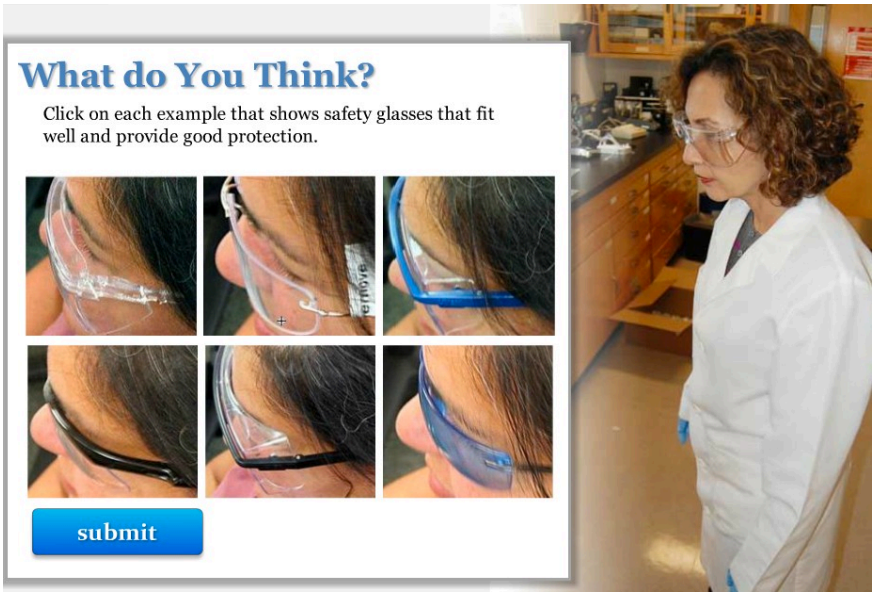
Personal protective equipment is very important to your safety, but it is considered the least effective control.

This is because if your personal protective equipment "fails", for example if a chemical glove is damaged, or if the glove is the wrong type for the chemical being used, the chemical can "breakthrough" which could result in your being exposed.

In this section we go over the types of PPE used in chemical labs.

Safety Glasses Activity

April is provided safety glasses but realizes they are too large to provide good protection at least for the work she will perform; They slip off easily and are uncomfortable to so she doesn't like wearing them. Because of this she is given a number of different pairs to try on as shown here.



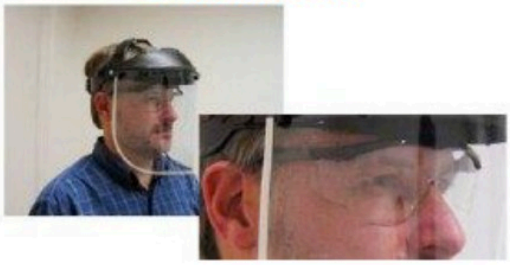
Click on each pair of safety glasses that you think fit April well and provide good protection.

Safety Glasses

Cover Safety Goggles

- Cover safety goggles are required for operations involving a greater risk of exposure to chemicals, flying particles, and for activities that produce airborne eye irritants.
- **Use non-vented goggles** when handling chemicals that produce irritating fumes and gases such as concentrated sulfuric acid.

Face Shields

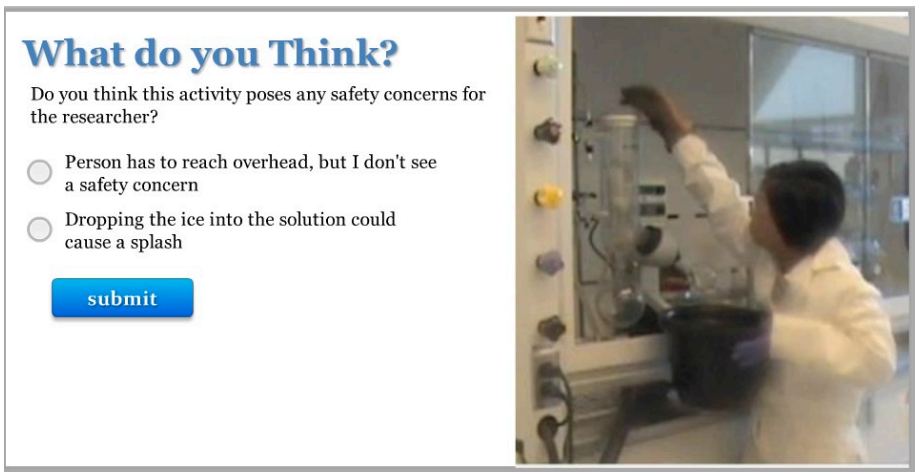


- Face Shields offer impact and splash protection to the face
- Face Shields are tested only as a secondary barrier, and must always be worn in combination with safety glasses or goggles (as shown).

April has been told that safety glasses are really designed to provide impact protection from flying objects, and that even though they may provide some level of splash protection, she knows they are not designed to protect against chemical splash, because the splash can easily get past the gaps at the tops and sides.

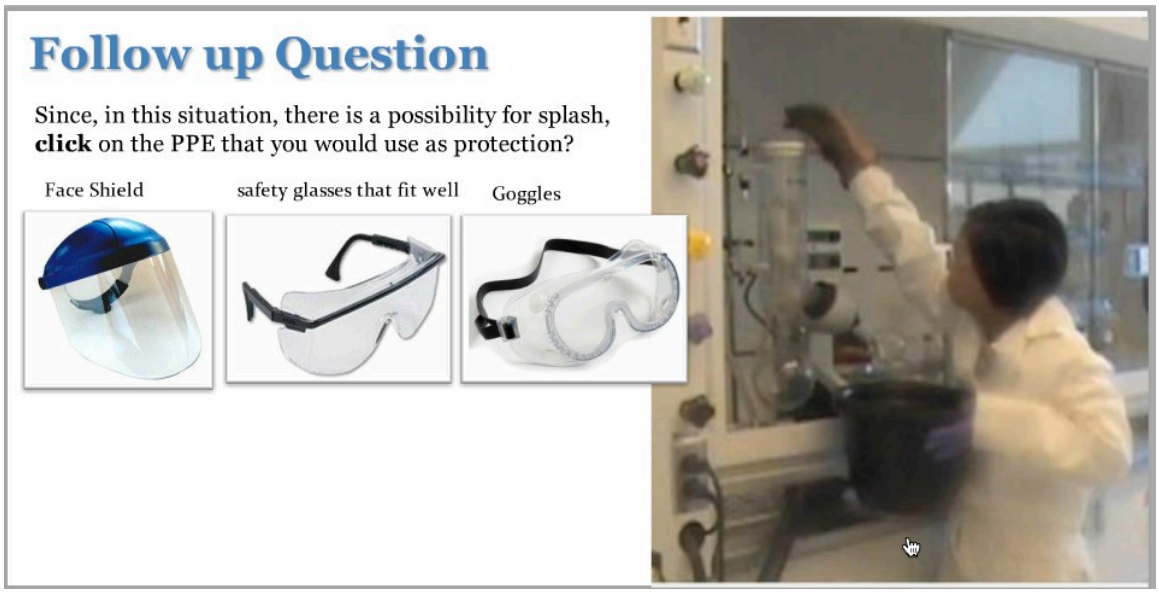
When she needs greater protection she chooses goggles or a face shield as shown here.

PPE Activity (Video)

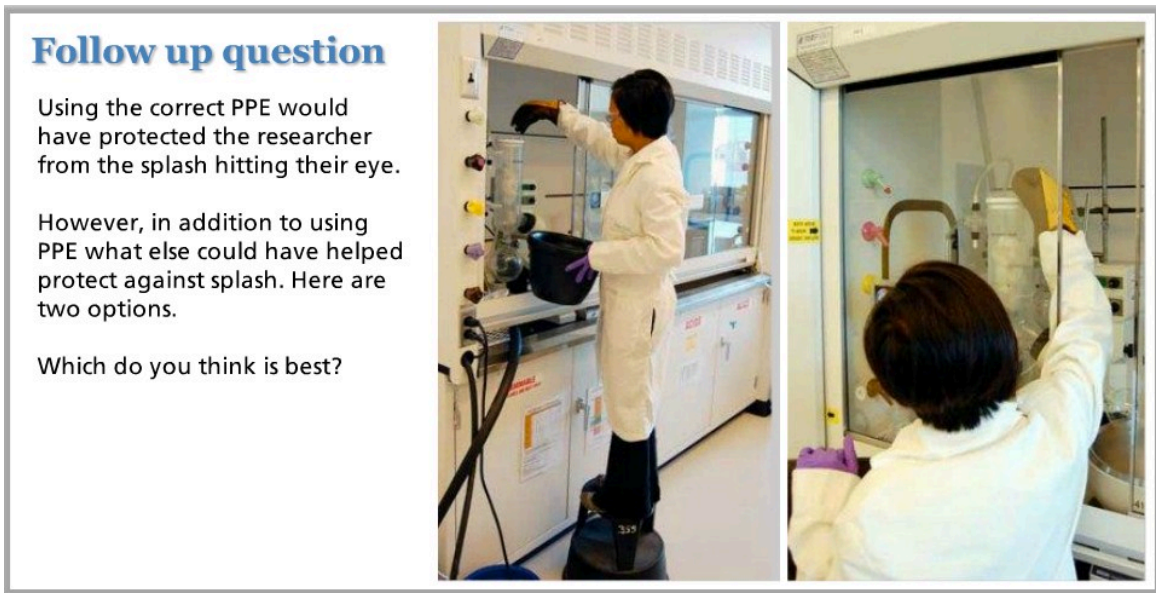


After you watch this video you will be asked a few questions based on what you see. This researcher is adding dry ice to an evaporator positioned inside a fumehood.

Activity Question 2



A face shield and safety glasses, or goggles would have provided good options.



Using the correct PPE would have protected the researcher from the splash hitting their eye. However, in addition to using PPE what else could have helped protect against splash. Here are two options. Which do you think is best?

Feedback for choosing step stool: The problem here is that using a step stool introduces another hazard - possibly losing balance and falling.

Chemical Gloves

Next we look at glove selection

Glove selection

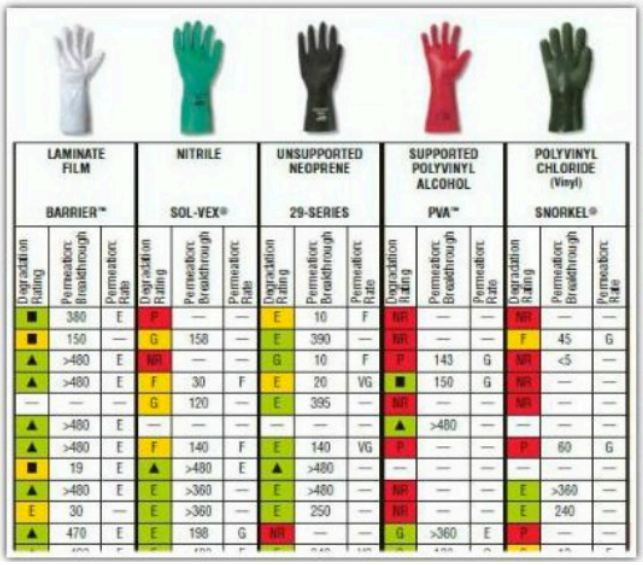
Material	Advantages	Intended use
Latex (natural rubber)	Good for *biological and water-based* materials. Poor for organic solvents.	Incidental contact
Nitrile	Good for solvents, *oils*, greases, and some acids and bases; and as an alternative for latex allergies.	Incidental contact
Butyl	Good for *ketones* and esters. Poor for gasoline and alphatic, aromatic, and halogenated hydrocarbons	Extended contact
Neoprene	Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons, and *phenols*	Extended contact
Norfoil	Good for most hazardous chemicals	Extended contact
Viton	Good for chlorinated and aromatic solvents. Poor for ketones.	Extended contact
Polyvinyl chloride (PVC)	Good for acids, bases, oils, fats, peroxides, and amines	Specific use
Polyvinyl alcohol (PVA)	Good for aromatic and chlorinated solvents. Poor for water-based solutions.	Specific use

When it comes to choosing gloves, it is important to remember that no single chemical glove is resistant to all chemicals. This is why chemical gloves come in a variety of materials. Review the chart below to learn about glove materials, their advantages and intended use.

Glove selection Guides

Choosing the right glove

Published permeation rate, breakthrough time, and degradation.



LAMINATE FILM BARRIER™			NITRILE SOL-VEX®			UNSUPPORTED NEOPRENE 29-SERIES			SUPPORTED POLYVINYL ALCOHOL PVA™			POLYVINYL CHLORIDE (Vinyl) SNORKEL®		
Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
■	380	E	P	—	—	E	10	F	NR	—	—	NR	—	—
■	150	—	G	158	—	E	390	—	NR	—	—	F	45	G
▲	>480	E	NR	—	—	G	10	F	P	143	G	NR	<5	—
▲	>480	E	F	30	F	E	20	VG	■	150	G	NR	—	—
—	—	—	G	120	—	E	395	—	NR	—	—	NR	—	—
▲	>480	E	—	—	—	—	—	—	▲	>480	—	—	—	—
▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G
■	19	E	▲	>480	E	▲	>480	—	—	—	—	—	—	—
▲	>480	E	E	>360	—	E	>480	—	NR	—	—	E	>360	—
E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—
▲	470	E	E	198	G	NR	—	—	G	>360	E	P	—	—

These are two properties to consider when choosing chemical protective gloves. (pop-up info)

- Chemical degradation
- Permeation breakthrough time

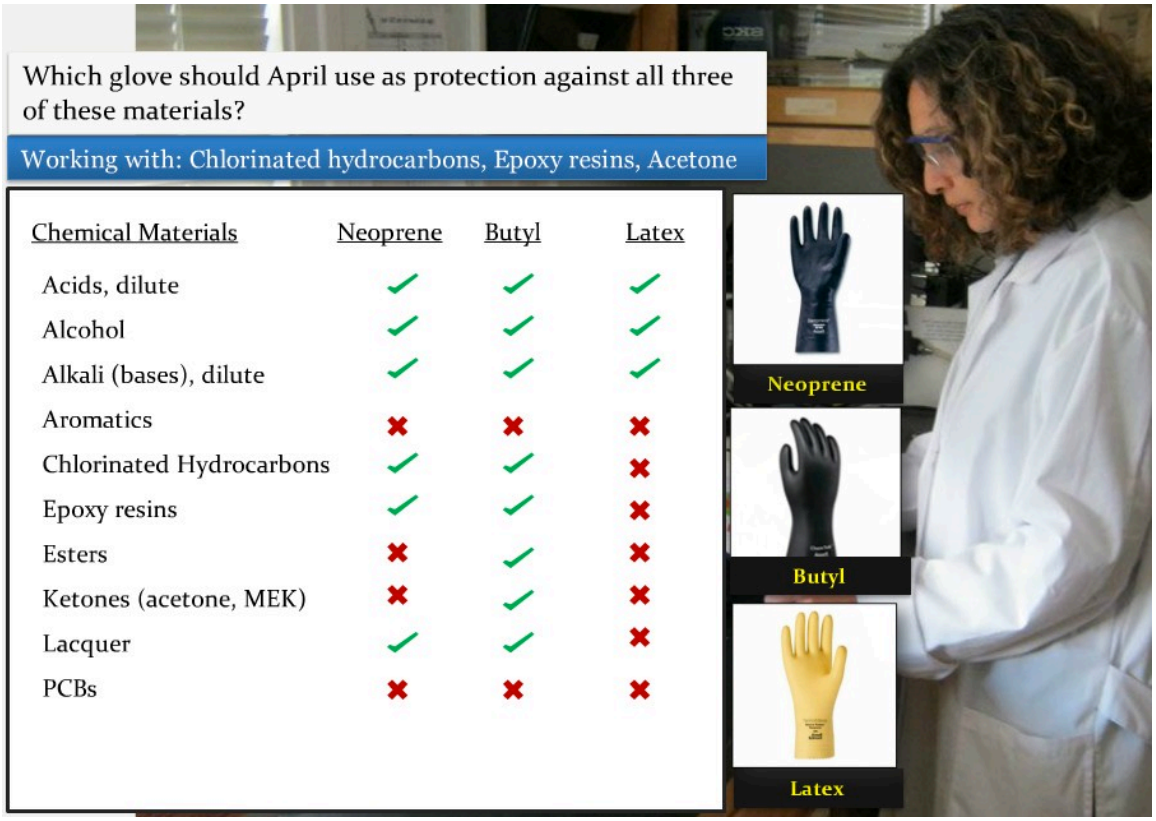
When working with gloves, you can check the manufacturer's chemical resistance guides. You should select gloves by taking into consideration the published permeation rate, breakthrough time, and degradation. Your work lead can help you choose the appropriate glove for your work. The LBNL Chemical Hygiene and Safety Plan has several databases for choosing gloves.

Chemical Degradation

Contact with chemicals can reduce one or more physical properties of a glove material. Certain glove materials may become hard, stiff, or brittle. For example, organic solvents will dissolve latex rubber. If a chemical has a significant impact on a glove material, the permeation resistance is quickly diminished.

Back

What do you think?

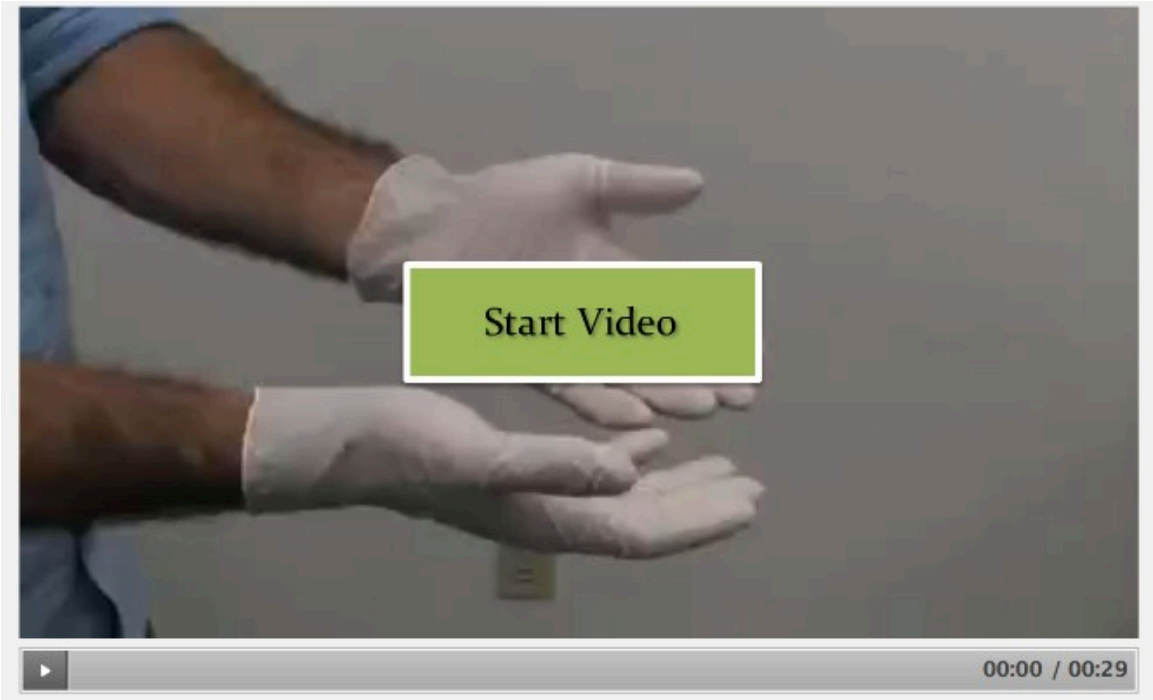


April is planning ahead. She knows that she will be working with Chlorinated hydrocarbons, Epoxy resins and Acetone. She is reviewing this glove chart in order to choose a glove that will protect against all three of these materials.

Q: Which glove should April use? Click on the glove to choose.

Removing gloves video

Watch video for how to remove contaminated gloves



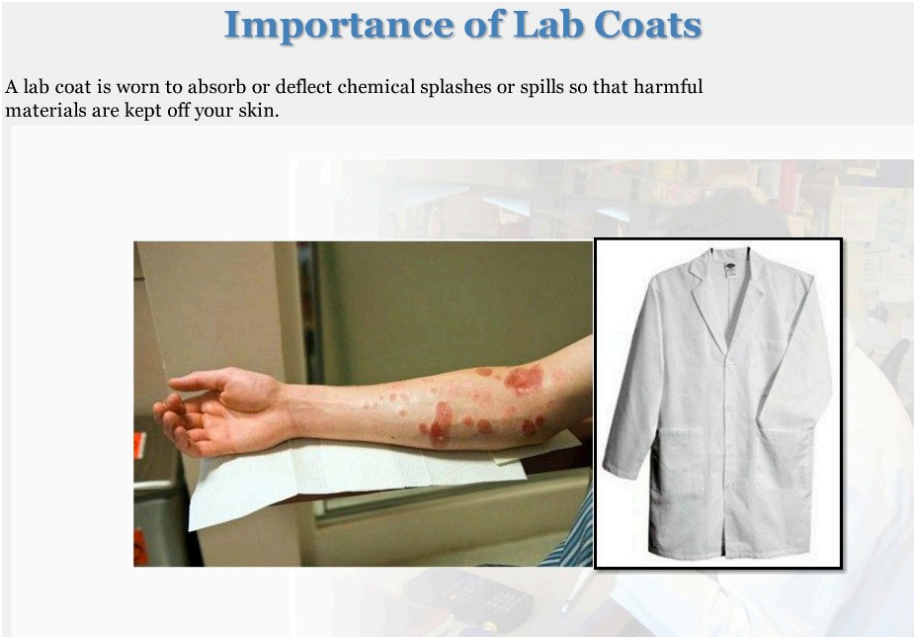
If you splash any amount of chemical onto your gloves remove them immediately and wash your hands. This short video shows how to safely remove contaminated gloves so that chemical residue does not come in contact with your skin.

Be sure to wash your hands and to dispose of the gloves properly. Gloves determined non-hazardous can be disposed of in the regular trash. If your professional judgment determines they have sufficient chemical contamination on the gloves dispose of as hazardous waste. Judgment.

Lab coats

Next we'll go over different lab coats and the varying level of protection they offer

Importance of Lab Coats



A lab coat is worn to absorb or deflect chemical splashes or spills so that harmful materials are kept off your skin. This is a picture of a student who was not wearing a lab coat and suffered substantial burns when splashed with Olelylamine (a viscous and corrosive organic chemical).

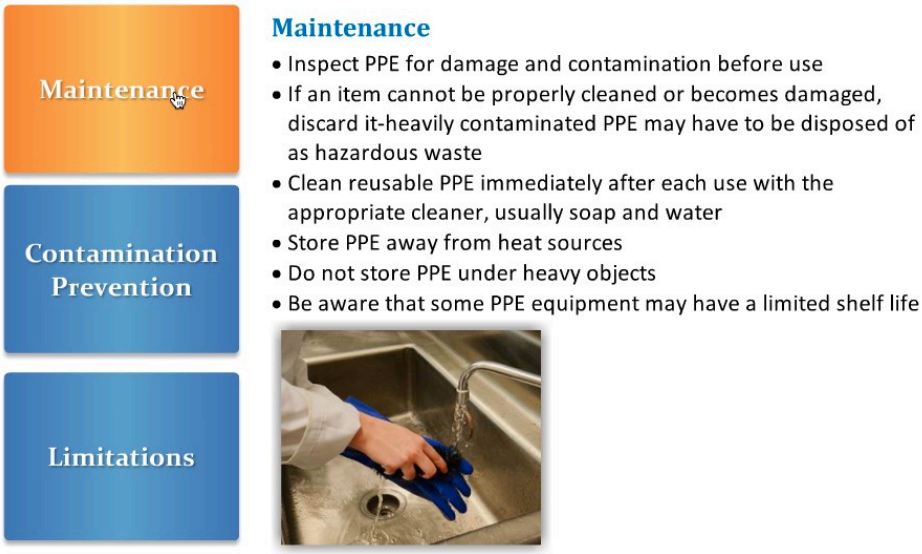
The injury would likely have been prevented had they worn a lab coat.

Lab Coat Types

However not all lab coats offer the same level of protection.
Flame resistant (FR) lab coats may be required when handling pyrophoric/air/water reactive materials, open flames, and certain quantities of flammable liquids.

for information about different types of lab coat materials and their use click these information links.

Personal Protective Equipment Know-How



Contamination Prevention

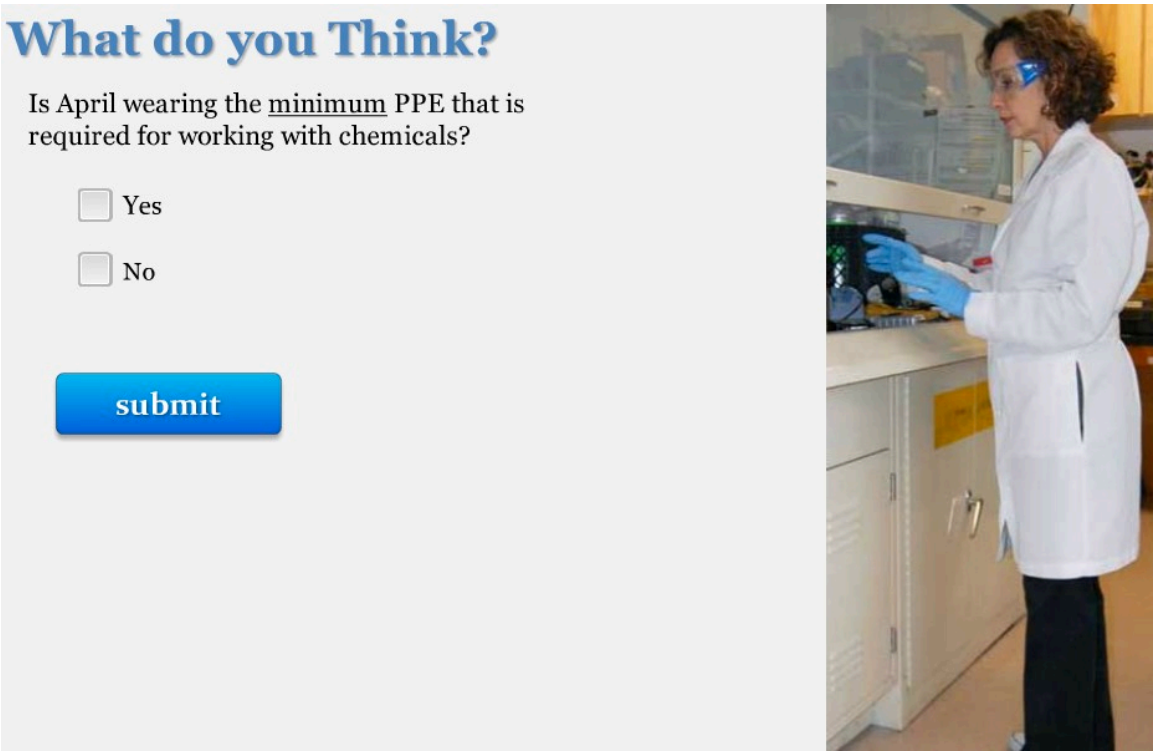
- Wear disposable items only once, and replace immediately if contaminated
- After use, always assume PPE is contaminated
- Remove PPE prior to leaving the lab
- Know the proper methods for donning, doffing, and fit-checking your PPE

Limitations

- Each PPE item has its limitations, and no single piece of PPE will protect you from all hazards
- Consider chemical compatibility and degradation time for gloves
- Be aware that PPE may limit your dexterity, vision, grip strength, or comfort, and plan accordingly

What do you Think?

April is a researcher who as you can see is getting ready to perform an experiment in a fume hood. Is April wearing the minimum PPE that is required for working with chemicals?

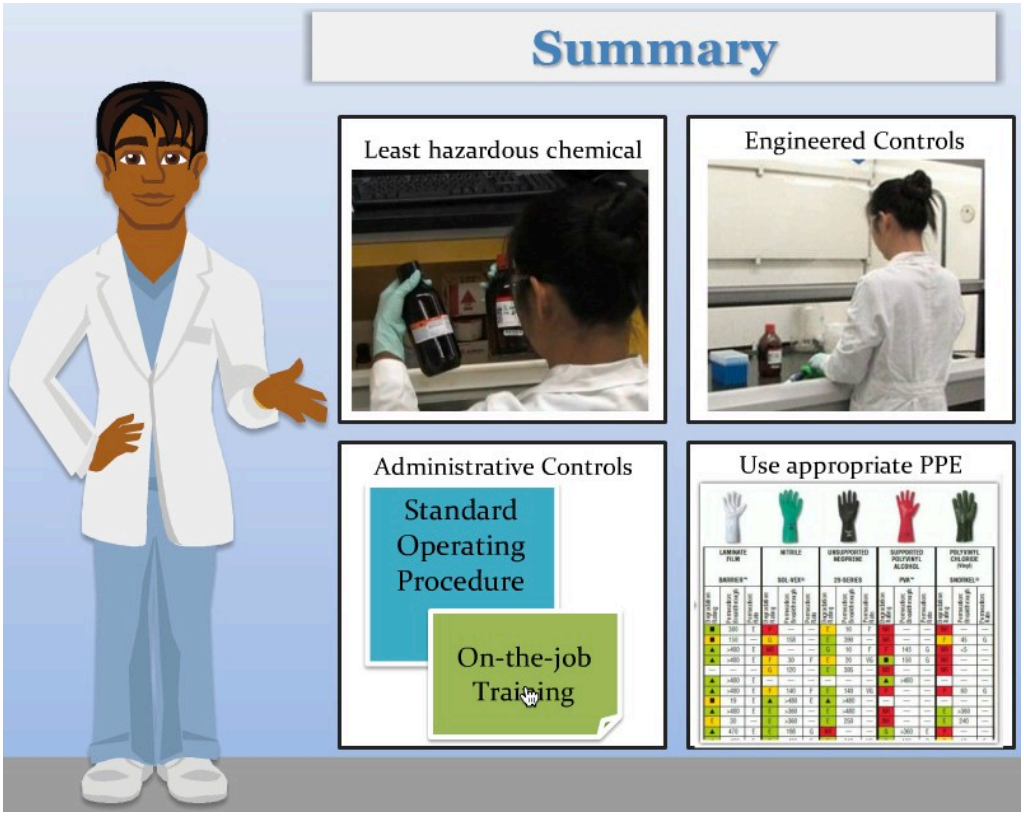


Correct: The minimum PPE is listed on the caution placard that's at the entrance to your work area and includes:

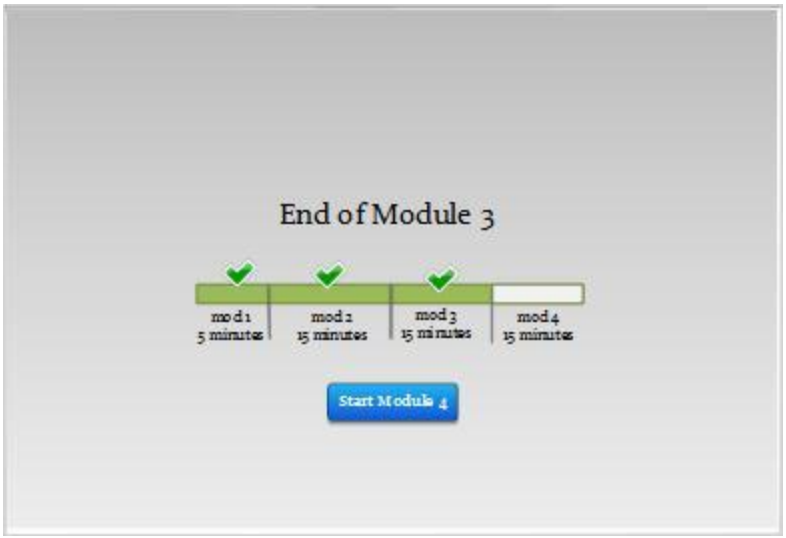
- safety glasses with side shields,
- chemical resistant gloves,
- closed-toed shoes
- long pants
- lab coat

Additional PPE may be required based on your work

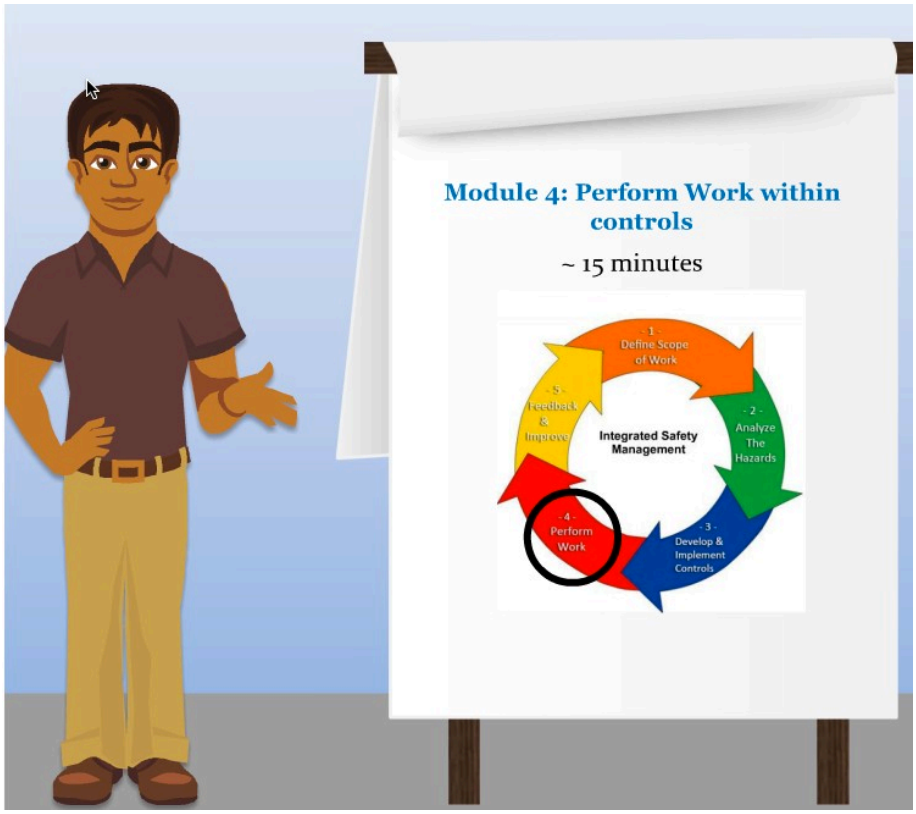
Module summary



In summary, we discussed different controls used to reduce exposure
- Choosing the least hazardous chemical when alternatives exist
- using appropriate engineered controls
- following safe work procedures and completing on the job training
- and choosing effective PPE



Module 4: Working within Controls



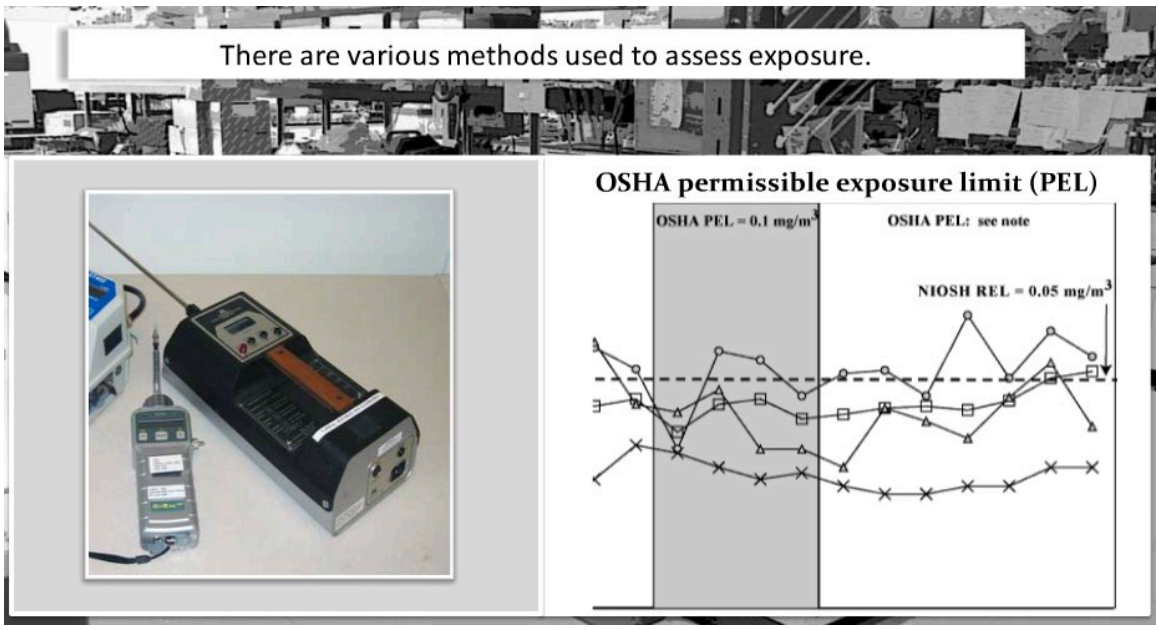
In this final module, we go over topics related to performing work within established controls and emergency response.

Exposure Monitoring

In most cases working within established controls provide adequate protection against harmful exposure to chemicals, however there are times when EHS safety professionals perform exposure monitoring to confirm that existing safeguards are adequate.

Monitoring may also be performed when:

- An employee or supervisor requests it
- if Health Services sends a referral
- or if an EHSS observation indicates that monitoring is needed



Various types of methods are used to assess exposure. Most often, air measurements are taken to determine the type and concentration of airborne chemicals.

The results of the monitoring are compared to the permissible exposure limits established by OSHA. If this is done in your work area, you will be notified of the results by EHS.

Another type of monitoring we perform is called swipe sampling. This is done to detect the presence of chemical residue on work surfaces, equipment, and floors. This method is used, for example, to detect mercury contamination.

Chemical Warning Properties

In addition to monitoring performed by EHS, you may detect the presence or release of a hazardous chemical . This is because many chemicals have warning properties.

These include characteristic smells, tastes or, eye irritation. Substances with good warning properties can be perceived at low airborne concentrations. This can allow you to respond (for example, leave the area) before any harm is done.

Ammonia illustrates this point. Most of us are familiar with ammonia's sharp and pungent odor. Ammonia can be smelled at an airborne concentration that is lower than the level that can harm you. Like ammonia, many, but not all chemicals, have warning properties. Safety Data Sheets are a good source for identifying chemical warning properties. In addition, LBNL's Chemicals Hygiene and Safety Plan has a list of odor thresholds for many chemicals.

It's important to know that if you can detect a chemical in your work area, you should inform your Work Lead in order to improve controls, for example, using smaller quantities and working in a fume hood. You should also contact EHSS, who will assess the situation by performing exposure monitoring.

Housekeeping

This lab serves as an example of good housekeeping practices. You can see that the work surfaces are orderly and clean and you get the overall sense that housekeeping is a priority. Good housekeeping is important because it reduces inadvertent exposure to chemicals which helps to keep you and your coworkers safe.

On the other hand, here's an example of a lab with very poor housekeeping. It is an extreme example for sure, but it illustrates the point. The benchtop work surface is covered in chemical residue, and it's clear that housekeeping is not a priority. It's also easy to see how a worker could come in contact with chemical residues which may cause chemical burns, dermal absorption, or skin irritation. There is also a potential for accidental ingestion of chemical as a result of hand-to-mouth transfer.

To maintain good housekeeping, wipe drips and residues from bench tops, fume hood work surfaces, and from bottles and containers.

An other housekeeping priority is to make sure to keep walkways and access to exits free of clutter and be sure to maintain obstruction-free access to emergency equipment.
For example, in this situation there is a garbage can and broom obstructing access to the eyewash shower. In this example there is a lab coat rack and garbage cans blocking access to the eyewash shower and to the fire extinguisher.

In an emergency situation having to move items to get to an eyewash or fire extinguisher could have grave impact.

Housekeeping also covers common sense rules related to food and drink, washing and contact, and personal attire. Click each tab to learn about each.

Food and Drink

- Consume and store food and drinks outside of the laboratory
- Never bring open food or beverage containers into the laboratory
- Never smoke or chew gum or tobacco in the laboratory

Washing and Contact

Wash hands frequently during and after work to minimize exposure through:

- Ingestion
- Skin contact

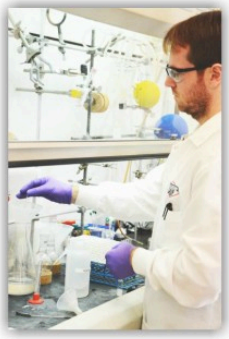
Do not:

- Rely on hand sanitizers to clean your hands
- Use solvents to clean your skin
- Handle contact lenses or touch your face and eyes
- Apply cosmetics (including lip balm)
- Touch common surfaces with gloved hands; e.g. door handles, telephone receivers

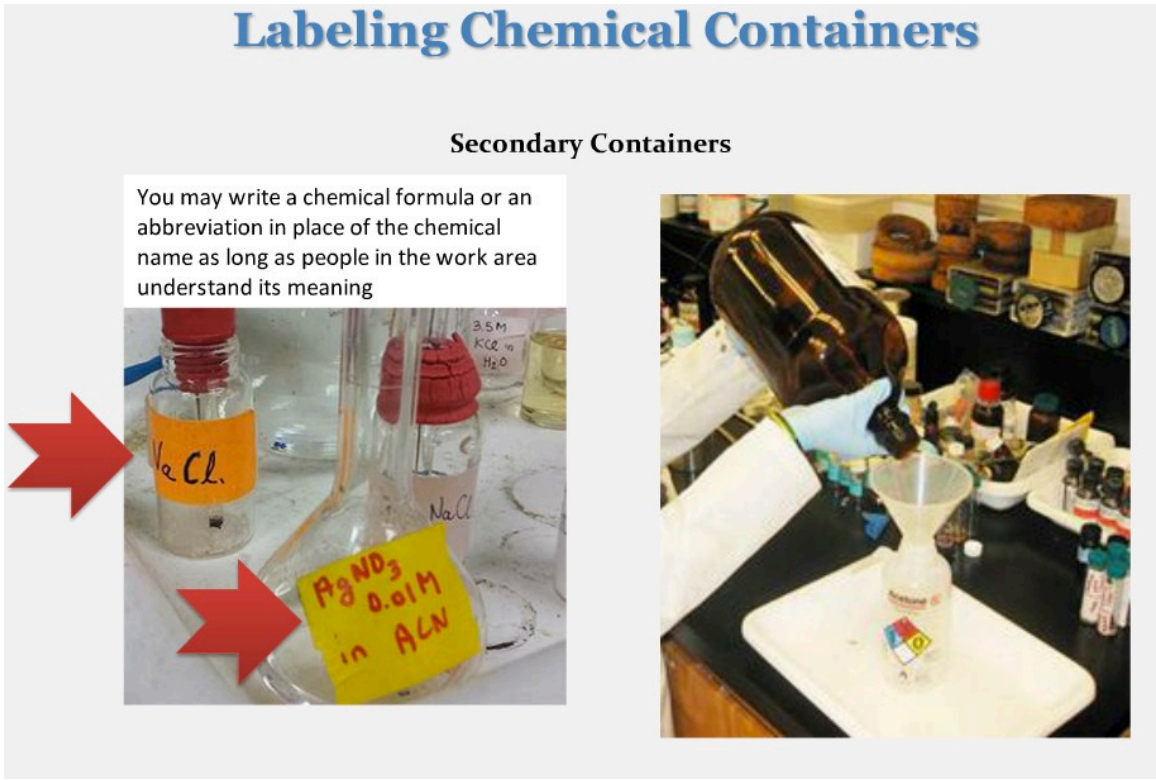
Attire

In order to be properly attired while working in the lab, you must:

- Use appropriate personal protective equipment (PPE)
- Remove PPE when leaving the laboratory



Labeling Chemicals



Labels are required for primary and secondary containers of hazardous materials.

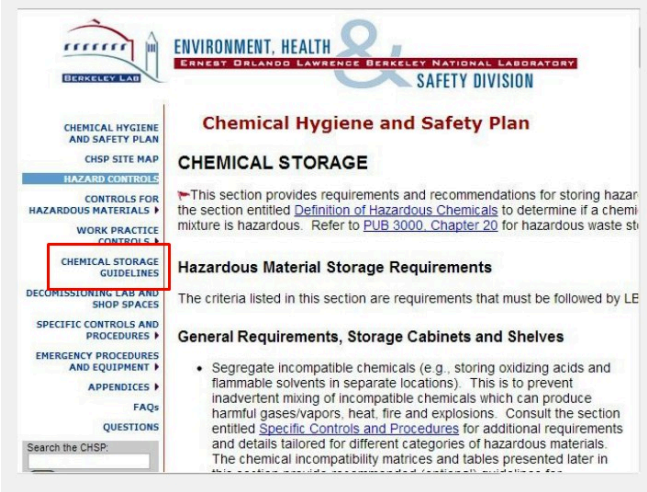
Primary containers are the original containers received from the manufacturer. Secondary containers are jars, cans, squeeze bottles and other containers to which hazardous materials are transferred by an individual.

OSHA requires that labels on primary containers list the chemical identity or product name, a hazard warning and the name and address of the manufacturer.

There are no specific OSHA requirements for labeling secondary containers in laboratories, but when you transfer a chemical from its original container to another one, LBNL requires that you write the chemical name on the new container.

You may write a chemical formula or an abbreviation in place of the chemical name as long as people in the work area understand its meaning. Listing the hazard warning, your name and date of transfer is optional. You can also buy pre-labeled squeeze bottles or obtain labels from the industrial hygienist who provides service to your division.

Storage compatibility



Since chemicals are often transferred to secondary containers such as plastic bottles, it is important to understand that chemicals can affect the strength and flexibility of plastics and cause them to deteriorate over time. It's also important to understand that there are different types of plastics used to make bottles, so it's important to choose a material that is resistant to the chemical it will store. For example, acetone, a common laboratory solvent, can react with bottles made of low-density polyethylene, but will not damage polypropylene bottles. The Chemical Hygiene and Safety Plan includes a selection guide for matching the material of a bottle with the chemical that will be stored in it.

Storage compatibility

Segregating chemicals

Again, the LBNL Chemical Hygiene and Safety Plan is an excellent source for learning about the specific storage requirements for the chemicals you use.

First. Chemicals must be stored and segregated according to hazard class to prevent accidental mixing. Why? mixing incompatible chemicals can result in a fire, a violent reaction, pressure build up, or a dangerous by-product.

For example, Keep flammable and combustible liquids segregated from oxidizers such as nitric acid and hydrogen peroxide.
Keep Acids segregated from bases, and keep acids and bases segregated from flammables.

To help with this process, acids are stored in approved and labeled cabinets often below fume hoods, or as stand alone cabinets. Flammables and combustibles are stored in approved Flammable cabinets (or lockers).

3.16 Storing Safely

All liquids must be kept in drip trays, also known as photo trays. If a bottle is broken, the trays will contain the liquid and minimize the risk of the spill. Drip trays are made of plastic (such as high density polyethylene) stainless steel or glass. It's important that you understand the chemical resistance of the tray material to the chemicals you plan to keep in them.

Solids such as inorganic salts can be stored on shelves. Shelves should be fitted with a restraint such as a plastic lip or a chain to keep containers on shelves in the event of an earthquake.

Transportation

Video goes over transportation policy for transporting small quantities of chemicals.

Refer to the Chemical Hygiene Safety Plan to understand the policy and procedures for transporting chemicals.

Emergency Response

In this last section we go over what to do if exposed to chemicals and spill response.

Personal Exposure Emergency

It's important to know what to do if you or a coworker are exposed to chemicals. In all cases call 911 from your office or cell phone if the injury is serious or life-threatening.

- Inhalation: If the material or its reaction/combustion products are inhaled, remove the person from the area and transport him or her to Health Services (Building 26). For serious exposures, call 911 from your office or cell phone. Lay the individual down, and keep him warm and rested until medical care can be provided.

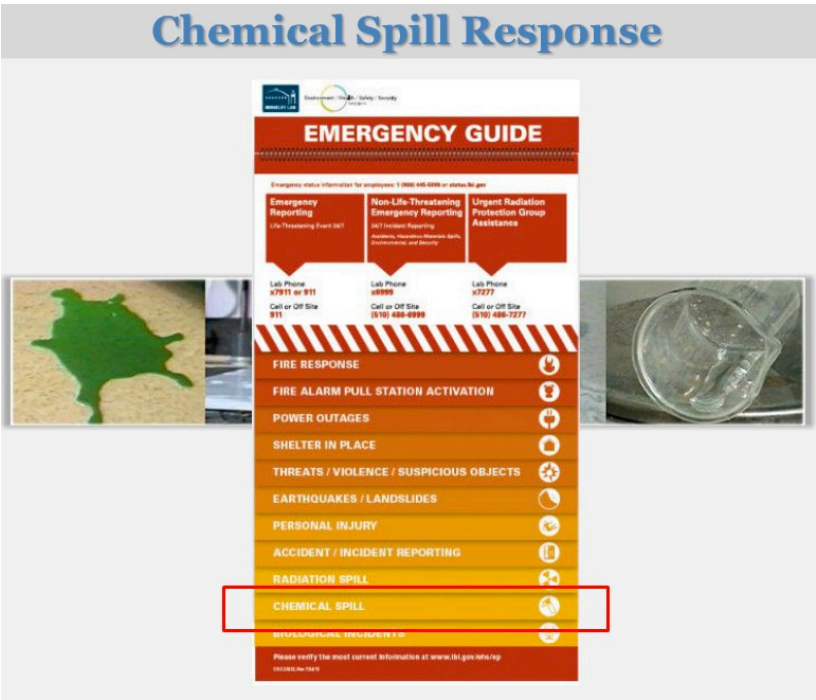
- Skin or eye contact: If chemicals splash onto your skin or eyes, flush the affected area for at least 15 minutes. Wash hands and arms in a sink. For eye and face splashes, use an emergency eyewash. In the event of whole body exposure, remove clothing and wash off the contamination with a safety shower. Then immediately report or have someone take you to Health Services (Building 26, extension 6266). Call 911 from your office or cell phone if the injury is serious or life-threatening. Special procedures are required for water reactive chemicals, phenol and hydrofluoric acid. If you use these chemicals, ask your Work Lead will explain them to you.

- Ingestion: If spontaneous vomiting occurs or appears imminent, help the person keep their airway clear. If the person affected is unconscious or cannot sit up, turn them on their side to prevent aspiration of vomitus. Never give liquid to a person who shows signs of drowsiness or falling unconscious. Call 911 from your cell phone.

- Injection: If you experience a laceration, cut or puncture wound when handling sharps contaminated with chemicals the first thing to do is to stop the bleeding and Rinse out the wound with clear water. Soap can irritate an open wound. Minor cuts

and scrapes usually stop bleeding on their own. If they do not, apply gentle pressure with a clean cloth or Kimwipe. Report all laceration and puncture injuries to Health Services (Building 26, extension 6266).

Spill Response



There are a lot of factors to consider for determining if it's safe to clean up a chemical spill. All of this information is in the LBNL Emergency Guide.

You should thoroughly review this information with your work lead before starting work with chemicals.

All lab workers should know the following:

- The location of the spill clean-up supplies in your lab. In this example the location is designated with a posting.
- You should know that there are different types of spill kits (some are for use acids) (some are for use with bases or caustics) and some for solvents.
- The Chemical Hygiene and Safety Plan provides guidance on selecting and buying spill kits.
- You should also know how to safely use spill clean-up supplies - before a spill happens.

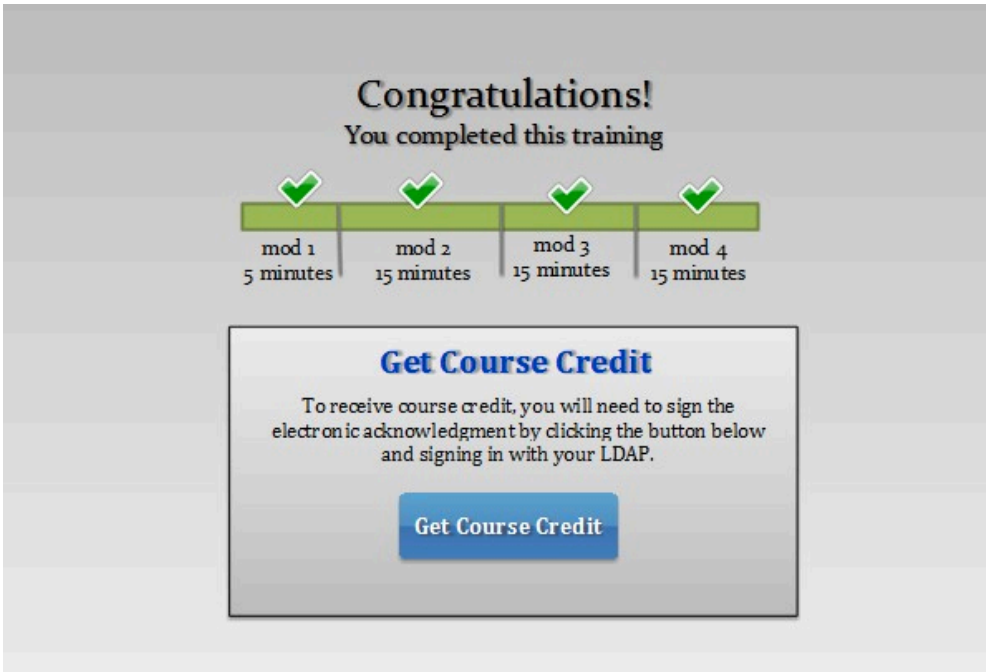
Discuss this process with your work lead before starting work with chemicals.

This is an excerpt of the chemical Spill section of the LBNL Emergency Guide.

This section is based on the SWIMS model (Stop and Think, Warn others, Isolate the area, monitor yourself carefully, and stay in or near the area until help arrives.

You can download a pdf version of the spill response guide by going here: http://www.lbl.gov/ehs/ep/

End of Training



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